NOTICE

All drawings located at the end of the document.

21100 WP OU 8 01
VOLUME I

PHASE I RFI/RI WORK PLAN FOR OPERABLE UNIT 8 700 AREA

VOLUME I - TEXT

OCTOBER 1994

2/26

FINAL

PHASE I RFI/RI WORK PLAN

ROCKY FLATS PLANT

700 AREA

OPERABLE UNIT NO. 8

U.S. DEPARTMENT OF ENERGY

Rocky Flats Plant

Golden, Colorado

ENVIRONMENTAL RESTORATION PROGRAM

December 1, 1992

Volume I of IV

Text

1/26

ADVANCED SCIENCES, INC

November 30, 1992

Mr. Bruce Peterman
Project Manager - Operable Unit 8
EG&G Rocky Flats, Inc.
Building 80
P O. Box 464
Golden, Colorado 80402-0464

Subject Transmittal of Final OU8 RFI/RI Work Plan
(Task Order 215362SH, BOA BA 72429PB)
ASI Project No., 9208.14.13

Dear Mr. Peterman;

In accordance with the revised schedule for this Project dated September 11 (modified 9/30/92), Advanced Sciences Inc , (ASI) is pleased to submit six (6) copies of the Volumes I, II, III, and IV of the Final RFI/RI Work Plan for Operable Unit 8 at the U.S. Department of Energy, Rocky Flats Plant facility near Golden, Colorado.

This work plan includes all necessary revisions to the text, tables, and figures to address and dispose of the written comments received from the Colorado Department of Health, U. S Department of Energy EM-453, and U. S. Environmental Protection Agency concerning the Draft Work Plan submitted on June 22, 1992. Included, herewith as separate documents, please find ASIs written responses to each of the comments received.

In accordance with your instructions, on or before close of business December 4, 1992, ASI will submit to EG&G the remaining fourteen copies and one electronic copy of the complete Final Work Plan. As per your request, the total of twenty copies will be provided in lieu of the twenty-five copies specified in our approved contract dated March 30, 1992.

With submittal of the outstanding copies of the Final Work Plan ASI has completed all of the contracted work and deliverables contained and described in the approved contract scope of work. Should you have any questions please do not hesitate to contact me at ASIs offices in Lakewood, Colorado at 303-980-0036.

Sincerely;

James D. Shaffer

James D. Shaffer
ASI OU8 Task Manager

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INFORMATION ONLY

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PER R B. HOFFMAN, CLASSIFICATION OFFICE
JUNE 11, 1991

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LIST OF ACRONYMS

AEC	U.S. Atomic Energy Commission
AIP	Agreement in Principle
APEN	Air Pollution Emissions Notice
ARAR	Applicable or Relevant and Appropriate Requirement
ASI	Advanced Sciences, Inc.
ASME	American Society of Mechanical Engineers
AWQC	Ambient Water Quality Criteria
BRA	Baseline Risk Assessment
BRAP	Baseline Risk Assessment Plan
BTEX	Benzene, Toluene, Ethyl-Benzene, and Xylene
CA	Controlled Area
CAD	Corrective Action Decision
CDH	Colorado Department of Health
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental, Response Compensation and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CMS	Corrective Measures Study
COC	Contaminants of Concern
CPS	Cancer Potency Slopes
CTET	Carbon Tetrachloride
CWA	Clean Water Act
CWAD	Clean Water Act Division
DCA	Dichloroethane
DCE	Dichloroethene
DCG	Derived Concentration Guide
DCN	Document Change Notice
DNAPLs	Dense Non-Aqueous Phase Liquids
DOE	U.S. Department of Energy
DQO	Data Quality Objective
DRCOG	Denver Regional Council of Governments
ECAO	Environmental Criteria Assessment Office
EE	Environmental Evaluation
EEWP	Environmental Evaluation Work Plan
EG&G	EG&G Rocky Flats, Inc.
EIS	Environmental Impact Statement
EMD	Environmental Management Division
EMRG	Environmental Management Radiological Guidelines
EOM	Environmental Operations Management
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration

LIST OF ACRONYMS - Continued

ERDA	Energy Research and Development Administration
ERP	Environmental Restoration Program
FFCA	Federal Facilities Compliance Act
FID	Flame Ionization Detector
FPXFR	Field Portable X-Ray Fluarescence
FS	Feasibility Study
FSAP	Field Sampling and Analysis Plan
FSP	Field Sampling Plan
GAC	Granular Activated Carbon
GC	Gas Chromatograph
GC/MS	Gas Chromatograph/Mass Spectrometer
GPR	Ground Penetrating Radar
GRRASP	General Radiochemistry and Routine Analytical Services Protocol
H&S	Health & Safety
HEAST	Health Effects Assessment Summary Tables
HF	Hydrofluoric Acid
HHRA	Human Health Risk Assessment
Hnu/OVA	HNu® Organic Vapor Analyzer
HPGe	High Purity Germanium Detector
HRR	Historical Release Report
HSL	Hazardous Substance List
HSP	Health and Safety Plan
HSU	Hydrostratigraphic Unit
IAG	Interagency Agreement
IARC	International Agency for Research on Cancer
ICRP	International Commission on Radiological Protection
IDL	Instrument Detection Limit
IHSS	Individual Hazardous Substance Site
IRIS	Integrated Risk Information System
KOH	Potassium Hydroxide
LNAPLs	Light Non-Aqueous Phase Liquids
LWA	Lee Wan & Associates
M&TE	Measuring and Test Equipment
MCLs	Maximum Contaminant Levels
MDL	Minimum Detection Limit
MEK	Methyl Ethyl Ketone
MetSta	Meteorological Station
MSL	Mean Sea Level
NaI	Sodium Iodide
NaOH	Sodium Hydroxide
NCP	National Contingency Plan
NCRP	National Commission Radiological Protection

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LIST OF ACRONYMS - Continued

NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
OPS	Operating Procedure
OPWL	Original Process Waste Line
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PA	Protected Area
PAC	Potential Areas of Concern
PAH	Polycyclic Aromatic Hydrocarbon
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCBs	Polychlorinated Biphenyls
PCE	Perchloroethene Tetrachloroethene
pCi	Picocuries
PID	Photoionization Detector
PM	Particulate Matter
PPCD	Plan for Prevention of Contaminant Dispersion
PQL	Practical Quantitation Limit
PRG	Preliminary Remediation Goals
PSZ	Perimeter Secured Zone
PU&D	Property Utilization and Disposal
PWL	Process Waste Lines
QA	Quality Assurance
QAA	Quality Assurance Addendum
QAPjP	Quality Assurance Project Plan
QAPM	Quality Assurance Project Manager
QC	Quality Control
RAAMP	Radioactive Ambient Air Monitoring Program
RAGS	Risk Assessment Guidance for Superfund
RAS	Routine Analytical Services
RCRA	Resource Conservation and Recovery Act
RDL	Required Detection Limit
RfD	Risk Reference Dose
RFEDS	Rocky Flats Environmental Database System
RFI	RCRA Facility Investigation
RFP	Rocky Flats Plant
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
RSP	Respirable Suspended Particulates
SAS	Special Analytical Services
SID	South Interceptor Ditch
SOP	Standard Operating Procedures

LIST OF ACRONYMS - Continued

SSH&SP	Site-Specific Health and Safety Plan
STP	Sewage Treatment Plant
SVOCs	Semi-Volatile Organic Compounds
SWADA	Safe Drinking Water Act
SWD	Surface Water Division
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCA	Trichoroethane
TCE	Trichloroethylene
TCL	Target Compound List
TICs	Tentatively Identified Compounds
TLL-α	Total Long-Lived Alpha
TM	Technical Memorandum
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSP	Total Suspended Particulates
UBC	Under Building Area of Concern
USGS	United States Geological Survey
UST	Underground Storage Tank
UV	Ultraviolet
VOC	Volatile Organic Compound
WQCC	Water Quality Control Commission
WWE	Wright Water Engineers, Inc.
XRF	X-Ray Fluorescence

INFORMATION ONLY

Approved by:

Manager, Remediation Programs 6/28/94 RFI Project Manager 6/28/94

1.0 INTRODUCTION

This document presents the Work Plan for the Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) for Operable Unit No. 8 (OU8) at the U.S Department of Energy (DOE) Rocky Flats Plant (RFP) in Jefferson County, Colorado.

This investigation is part of a comprehensive, phased program of site characterization, remedial investigations, feasibility studies, and remedial/corrective actions currently in progress at RFP. These investigations are pursuant to an Interagency Agreement (IAG) between DOE, the U.S. Environmental Protection Agency (EPA), and the State of Colorado Department of Health (CDH) dated January 22, 1991 (DOE, 1991b). The IAG addresses RCRA and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) issues Although the IAG requires general compliance with both RCRA and CERCLA, CERCLA regulations apply to remedial investigations at OU8. In accordance with the IAG, the CERCLA terms "remedial investigation" and "feasibility study" as used in this document are considered equivalent to the RCRA terms "RCRA Facility Investigation" and "Corrective Measures Study" (CMS), respectively Also in accordance with the IAG, the term "Individual Hazardous Substance Site" (IHSS) is equivalent to the term "Solid Waste Management Unit" (SWMU).

1.1 WORK PLAN SCOPE

As required by the IAG, this Phase I Work Plan addresses characterization of sources of contamination and environmental media at each IHSS in OU8. It will also address the nature and extent of contamination at each IHSS, migration pathways, and receptor exposure.

In this Work Plan, the existing information is summarized to characterize OU8, data gaps or other requirements are identified, data quality objectives (DQOs) are established, and a Field Sampling Plan (FSP) is presented to characterize site physical features, define contaminant sources, and assess the extent of contamination. Also included are plans to conduct a Human Health Risk Assessment (Section 8.0) and the Environmental Evaluation (Section 9.0).

The Phase I RFI/RI will be conducted in accordance with the Interim Final RCRA Facility Investigation (RFI) Guidance (EPA, 1989a) and Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA, 1988) Unless otherwise explained and rationale provided, the minimum investigative action required by the IAG, Attachment 2, Section VI, Table 5 (See Appendix A) will be performed at each IHSS within OU8. Existing data and data generated by the Phase I RFI/RI will be used to begin developing and screening remedial alternatives and to estimate the risks to human health and the environment posed by sources within OU8.

1.2 ENVIRONMENTAL RESTORATION PROGRAM AT RFP

The Environmental Restoration (ER) Program, designed for investigation and cleanup of environmentally contaminated sites at DOE facilities, is being implemented in five phases. Phase 1 (Installation Assessment) includes preliminary assessments and site inspections to assess potential environmental concerns. Phase 2 (Remedial Investigations) includes planning and implementation of sampling programs to delineate the magnitude and extent of contamination at specific sites and evaluate potential contaminant migration pathways. Phase 3 (Feasibility Studies) includes evaluation of remedial alternatives and development of remedial action plans to mitigate environmental problems identified during remedial investigations as needing corrective actions. Phase 4 (Remedial Design/ Remedial Action) includes design and implementation of site-specific remedial actions selected on the basis of feasibility studies. Phase 5 (Compliance and Verification) includes monitoring and performance assessments of remedial actions as well as verification and documentation of the adequacy of remedial actions carried out under Phase 4

Initial Phase 1 actions have been completed at RFP (DOE, 1986); in addition, Phase 2 actions are currently in progress for OU8. This Work Plan is intended to complete the additional Phase 1 activities to further locate and assess potential and known release sites and provide supplemental sampling and analytical data to evaluate the extent and magnitude of contamination onsite and offsite of individual IHSSs and OU8.

1.3 OVERVIEW OF WORK PLAN

This Work Plan presents an evaluation and summary of previous data and investigations, defines Data Quality Objectives (DQOs) and data needs based on that evaluation, specifies Phase I RFI/RI tasks, and presents the Field Sampling Plan (FSP) activities and procedures to be implemented during the OU8 Phase I RFI/RI.

This Work Plan is organized as follows:

- Section 1.0 provides introductory information and a general characterization of RFP. This includes a description of the Work Plan Scope, Environmental Restoration Program at RFP, an Overview of the Work Plan, Regional and Plant Site Background Information, and Previous Investigations. Included in this are discussions of the Physical Setting for topography and drainage, geology and soils, and hydrogeology.

- Sections 2.0 through 2.2 presents a comprehensive review and analysis of the available historical information, previous environmental investigations, recently published reports, available data, past and present activities pertinent to OU8, and interrelation of OU8 activities with those of other OUs.

  Sections 2.3 through 2.5 provide the Initial Evaluation of IHSSs within OU8, which includes conceptual models for contaminant migration and exposure pathways based on release mechanisms, site physical characteristics, and available information regarding the nature of contaminants and knowledge of Potential Areas of Concern (PACs). PACs are similarly evaluated and related to evaluation of contamination occurring at IHSSs within the immediate proximity. This initial characterization provides the basis for establishing data needs, DQOs, and for developing protocols, procedures and rationale for activities to be conducted during implementation of the FS.

- Section 3.0 presents potential sitewide Chemical Specific Benchmarks and discusses potential Applicable or Relevant and Appropriate Requirements (ARARs), as required by the IAG, and a discussion of their application to the RFI/RI activities at OU8.

- Section 4.0 provides a discussion of the tasks planned in this Phase I RFI/RI Work Plan Tasks. This section also discusses Preliminary Remedial Action Alternatives, including those for surface water and sediments, surficial materials and soils, groundwater, and air.

- Section 5.0 discusses the Sampling Rationale and the DQOs for the Phase I RFI/RI.

- Section 6.0 presents the FSP for the Phase I RFI/RI to satisfy the data needs pursuant to the DQOs (Section 5.0) and Quality Assurance Addendum outlined in Section 10.0 This includes the Field Sampling Rationale; Phase I RFI/RI Objective; Integration with RFP Standard Operating Procedures; Sampling Design, Location, and Frequency; Sample Collection and Analysis; and QA/QC Procedures and Addendum.

- Section 7.0 contains the preliminary schedule for performance of this Phase I RFI/RI Work Plan.

- Section 8.0 provides the Human Health Risk Assessment Plan. This includes the baseline risk assessment approach (BRA), Data Evaluation and Identification of Chemicals of Potential Concern, Toxicity Assessment, Exposure Assessment, Risk Characterization, Uncertainty Analysis, Derivation of Chemical Goals, Risks from Radionuclides, and Risk Assessment Report.

- Section 9.0 discusses the plans to perform an Ecological Evaluation at OU8.

- Section 10.0 provides the Quality Assurance/Quality Control Procedures and Addendum as supplied by EG&G for OU8.

- Section 11 0 lists references cited throughout this Work Plan.

- Appendix A (Tables 5 and 6, and Attachment 4) are from the IAG which outline the recommended scope of investigative activities for each OU8 IHSS and the schedule for completion of RFI/RI milestones.

- Appendix B presents additional information research by Doty & Associates on the history of operations and current conditions of each IHSS that was obtained during the preparation of this Work Plan.

- Appendix C contains a tabular summary of wells and boreholes along with geologic and hydrologic information surrounding OU8.

- Appendix D contains geologic logs and well-construction diagrams for wells and boreholes included in geologic cross sections presented in this Work Plan.

- Appendix E contains information concerning building footing drains at RFP as developed by Doty & Associates in support of this Work Plan.

- Appendices F and G provide analytical data for borehole, groundwater, surface water, and sediment samples.

1.4 REGIONAL AND PLANT SITE BACKGROUND INFORMATION

1 4 1 Facility Background

RFP is a government-owned, contractor-operated facility which is part of the nationwide Nuclear Weapons Complex. The plant was operated for the U.S. Atomic Energy Commission (AEC) from its inception in 1951 until the AEC was dissolved in January 1975. At that time, responsibility for the plant was assigned to the Energy Research and Development Administration (ERDA), which was succeeded by DOE in 1977. Dow Chemical U.S.A., an operating unit of the Dow Chemical Company, was the prime operating contractor of the facility from 1951 until June 30, 1975. Rockwell International was the prime contractor responsible for operating RFP from July 1, 1975 until December 31, 1989. EG&G Rocky Flats, Inc. became the prime contractor at RFP on January 1, 1990.

1 4.2 Rocky Flats Plant Operations

From 1952 to 1989 operations at RFP consisted of fabrication of nuclear weapons components from plutonium, uranium, and other nonradioactive metals (principally beryllium and stainless steel). Parts made at the plant were shipped elsewhere for assembly. In addition, the plant reprocessed components after they were removed from obsolete weapons for recovery of plutonium. Other activities at RFP have included research and development in metallurgy, machining, nondestructive testing, coatings, remote engineering, chemistry, and physics. Both radioactive and nonradioactive wastes are generated in the various production processes. Current waste handling practices involve onsite and offsite recycling of hazardous materials, offsite disposal of solid radioactive materials at another DOE facility, and onsite storage of hazardous and radioactive mixed wastes. However, RFP operating procedures historically included both onsite storage and disposal of hazardous, radioactive, and mixed wastes. Preliminary assessments under the Environmental Restoration (ER) Program have identified many of the past onsite accidental release sites and storage and disposal locations as potential sources of environmental contamination.

1.5 PREVIOUS INVESTIGATIONS

Various sitewide studies have been conducted at RFP to characterize environmental media and to assess the extent of radiological and chemical contaminant releases to the environment. The investigations performed prior to 1986 were summarized by Rockwell International (1986a) and include the following:

1. Detailed description of the regional geology. (Malde, 1955; Spencer, 1961; Scott, 1960, 1963, 1970, 1972, and 1975; Van Horn, 1972 and 1976; Dames and Moore, 1981; and Robson, 1983).

2. Several drilling programs beginning in 1960 that resulted in construction of approximately 60 monitoring wells by 1982.

3. An investigation of surface-water and groundwater flow systems by the U.S. Geological Survey (Hurr, 1976).

4 Environmental, ecological, and public health studies that culminated in an Environmental Impact Statement (EIS) (DOE, 1980).

5. A summary report on groundwater hydrology using data from 1960 to 1985 (Hydro-Search, 1985).

6. A preliminary electromagnetic survey of the RFP perimeter (Hydro-Search, 1986).

7. A soil-gas survey of the RFP perimeter and buffer zone (Tracer, 1986).

8. Routine environmental monitoring programs addressing air, surface water, groundwater, and soils (Rockwell, 1975 through 1985, and 1986a).

In 1986, two major investigations were completed at RFP. The first was the DOE Comprehensive Environmental Assessment and Response Program (CEARP) Phase 1 Installation Assessment (DOE, 1986b), which included analyses and identification of current operational activities, active waste sites and inactive waste sites; current and past waste management practices; and potential environmental pathways through which contaminants could be transported. CEARP was succeeded by the Environmental Restoration Program. A number of sites that could potentially have adverse impacts on the environment were identified. These sites were designated as SWMUs by Rockwell International (1987). In accordance with the IAG, SWMUs are now designated as IHSSs, which were divided into three categories:

1. Hazardous substance sites that will continue to operate and require a RCRA operating permit;

2. Hazardous substance sites that will be closed under RCRA interim status; and

3 Inactive hazardous substance sites that will be investigated and cleaned up under CERCLA or Section 3004(u) of RCRA.

The second major investigation completed at RFP in 1986 involved a hydrogeologic and hydrochemical characterization of the plant site. Plans for this study were presented by Rockwell International (1986b and 1986c), and study results were reported by Rockwell International (1986d). Investigation results identified areas considered to be significant contributors to environmental contamination

1.6 PHYSICAL SETTING

1.6.1 Location

The RFP is located in northern Jefferson County, Colorado, approximately 16 miles northwest of Denver (Figure 1-1). Other surrounding cities include Boulder, Westminster, and Arvada, all of which are located less than 10 miles to the northwest, east, and southeast, respectively. The plant consists of approximately 6,550 acres of federally-owned land in Sections 1 through 4 and 9 through 15 of Township 2 South, Range 70 West, 6th P.M. The majority of buildings located within the RFP site are concentrated on approximately 400 acres. The RFP controlled area (CA) is surrounded by essentially an unoccupied buffer zone of approximately 6,150 acres (Figure 1-2).

RFP is bounded on the north by State Highway 128, on the east by Jefferson County Highway 17 (also known as Indiana Street), on the south by agricultural and industrial properties and State Highway 72, and on the west by State Highway 93.

OU8 is located on approximately 150.85 acres in the north-central industrialized area of the RFP. The boundary of OU8 is polygonal in shape and encompasses a majority of the Production (high-security) Area of the plant site. Figure 1-3 locates the 24 IHSSs for which Phase I RFI/RI activities are planned and discussed in this Work Plan.

Information presented in the following discussion of IHSSs (Sections 2.3 and 2.5) is taken from descriptions presented in the Historical Release Report (DOE, 1992a and 1992b) for the RFP, engineering designs drawings, and facilities drawings. For several IHSSs, this information was recently updated by Doty & Associates, Golden, Colorado, as part of a subtask to preparing this Work Plan (Appendix B) This research has been included in the IHSS descriptions provided below. This research includes additional background information regarding release mechanisms, revisions to IHSS size and location, and the nature of operations and potential contaminants occurring at a given site.

1.6.2 Surrounding Land Use and Population Density

The population, economics, and land use of areas surrounding RFP are described in a 1989 Rocky Flats vicinity demographics report prepared by DOE (DOE, 1990). This report divides general use of areas within 0 to 5 miles of RFP into residential, commercial, industrial, parks and open spaces, agricultural and vacant, and institutional classifications and outlines current and future land use near the plant.

The majority of residential use within 5 miles (8 km) of RFP is located northeast, east, and south of the existing RFP. Figure 1-4 shows the 1989 population and residence distribution within a 5-mile radius from the center of RFP. Commercial development is concentrated near the residential developments around Standley Lake, primarily north and southwest, and around the Jefferson County Airport (Jeffco), which is located approximately three miles (4.8 km) northeast of RFP. Active industrial land use within 5 miles (8 km) of the plant is limited to quarrying and mining operations located on lands directly west and southwest of RFP property. There are several pockets of industrially zoned property located all around the property, both directly adjacent and nearby. This property is not likely to be developed any time in the near future due to a lack of water for fire protection. These properties must be accepted into a fire protection district in order to be developed for commercial or industrial use. To date, no Fire Protection

District has been willing to accept the property, and it is anticipated that these properties will remain undeveloped in the near future. Open Space lands are located northeast of RFP near the City of Broomfield, and in small parcels adjoining major drainages and small neighborhood parks in the cities of Westminster and Arvada. Standley Lake is surrounded by Standley Lake Park. Irrigated and non-irrigated croplands, producing primarily wheat and barley, are located northeast of RFP near the cities of Broomfield, Lafayette, and Louisville; north of RFP near Louisville and Boulder; and in scattered parcels adjacent to the eastern boundary of the plant. Several horse operations and small hay fields are located south of RFP

1.6.3 Future Population and Land Use Projections

Future land use in the vicinity of RFP most likely will involve continued suburban expansion, increasing the density of residential, commercial, and industrial land use in the surrounding areas. The expected trend in population growth in the vicinity of RFP is addressed in the DOE demographics study (DOE, 1990). This report considers expected variations in population density by comparing the current (1989) setting to population projections for the years 2000 and 2010. A 21-year profile of projected population growth in the vicinity of RFP can thus be examined. The DOE projections are based primarily upon long-term population projections developed by the Denver Regional Council of Governments (DRCOG). Expected population density and distribution around RFP for the years 2000 and 2010 are shown in Figures 1-5 and 1-6, respectively. Table 1-1 summarizes the population data presented in Figures 1-4, 1-5, and 1-6.

1.6.4 Topography

RFP is situated along the eastern edge of the southern Rocky Mountain region immediately east of the Colorado Front Range. RFP is at an average elevation of approximately 5,950 feet above mean sea level (MSL). The site is located on a broad, eastward-sloping alluvial surface. The surface of the alluvium is nearly flat but slopes gently eastward at 50 to 100 feet per mile

(EG&G, 1991k). At RFP, the alluvial surface is dissected by a series of east-northeast trending stream-cut valleys. The valleys containing Rock Creek, North and South Walnut Creeks, and Woman Creek are cut 50 to 200 feet below the level of the older alluvial surface in the vicinity of RFP.

1.6.5 Climate

1.6.5.1 Meteorology

Atmospheric transport of contaminants from RFP is controlled by climate, local meteorology, topography and land surfaces, on-site structures, and contaminant type and concentration. This information is necessary when evaluating the environmental and human health aspects attributable to atmospheric dispersion of OU8 IHSS site contaminants.

The climate at RFP is strongly influenced by the Front Range of the Rocky Mountains. Dry cool winters with some snow cover and warm intermittently moist summers are typical. The temperatures at RFP average a maximum of 24.4°C (76°F) and a minimum of -5.56°C (22°F). Annual mean temperature approximates 9.78°C (49.6°F). Recorded RFP temperature extremes range from 38.89°C (102°F) in July to -32.22°C (-2°F) in January (Schleicher and Schuell, 1982). Infrequent cloud cover over the region allows intense solar heating of the ground surface. The low absolute humidity permits rapid radiant cooling at night. Relative humidity averaged 46% for the period from 1954-1976 (Rockwell, 1986a).

Colorado has inconsistent visual air quality conditions. The atmosphere over much of the Rocky Mountains is aesthetically satisfactory. However, the Denver "brown cloud" and visibility problems commonly associated with individual Front Range communities exemplify the consequences of low-level atmospheric stagnation and thermal inversion that can occur with urban air pollutants emitted in Colorado (DOE, 1992).

Regional topography and upper-level wind patterns combine to create a semiarid climate along the foothills of the Front Range of the Rocky Mountains Average annual precipitation is approximately 15 inches with more than 80 percent of this falling as rain between April and September; the remaining precipitation is snow (Rockwell, 1986a)

Meteorology is influenced by local topography, regional mountain ranges, and large-scale weather systems. The orientation of the Front Range of the Rocky Mountains greatly affects local winds. The RFP lies in a belt of prevailing northwesterly winds that are normally channeled across the eastern geomorphological bench called Rocky Flats. High velocity winds have been recorded at the RFP under these meteorological conditions. High winds occur most frequently in the spring.

The RFP is affected by downslope winds from Front Range canyons. These channeled airflows are especially pronounced under conditions of strong atmospheric stability. Similarly, daily cycles of mountain and valley breezes occur at RFP. The general upslope air pattern condition for the Denver area is north to south with flows moving up the South Platte River Valley and entering Front Range canyons. After sunset the air that contacts mountain surfaces begins to cool and move downslope, thereby flowing in a pattern generally the inverse to upslope movements. Downslope flows converge with the South Platte River Valley flow and move toward the north-northeast.

Strong surface air convections commonly produce thunderstorms during the summer. This activity causes severe and locally unpredictable anomalies in normal air flows. Late winter and spring conditions can also be influenced by chinook windstorms. Chinooks consist of strong winds that move from west to east over the continental divide and often reach 70-80 mph. Chinooks have been recorded in excess of 120 mph at RFP (Rockwell, 1989a).

The mean wind speed at the RFP for 1990 was 9.0 mph. The highest reported wind speed was 88.6 mph. Figure 1.7 illustrates the annual RFP wind frequency distribution facing true bearing compass point directions (EG&G, 1991k) The predominance of northwesterly winds and the low frequency of winds greater than 15.6 mph (7 m/s) with easterly components is typical for RFP (DOE, 1992).

Although RFP site-specific data are limited, annual evaporation at the RFP site is estimated to be between 31 and 38 inches. This is based upon long-term records at Cherry Creek Dam and Fort Collins, respectively (ASI, 1991c).

1.6.5.2 Summary of Air Monitoring

Data Collection Systems

The air quality and meteorological monitoring programs currently in effect at RFP were designed to collect data on the entire facility, Air sampling stations have not been located or operated specifically in support of OU8. Continuous ambient air monitoring programs have emphasized characterization of airborne particulate material concentrations and accompanying radionuclides, particularly plutonium. A systematic program for measurement of volatile organic compound (VOC) concentrations in RFP ambient air has not been initiated; however, a dispersion model-derived ambient air concentration study was scheduled to be completed in late 1991 (EG&G, 1991l). Meteorological data is being collected at one location at RFP. Telemetered wind measurements are collected at the RFP 61-Meter Meteorological Tower indicated on Figure 1.2. Environmental instrumentation measures wind directions and both horizontal and vertical wind speeds at the 10-, 25-, and 60-meter heights on the meteorological tower. Additional data measured includes: dew point, solar radiation, precipitation, and barometric pressure (EG&G, 1991k).

Ambient air samplers are located in RFP site operations areas, at the plant perimeter (at distances of approximately 2 to 4 miles from the plant's center), and in surrounding communities (Figures

1-8 and 1-9) These RFP-designed air samplers operate at a volumetric flow rate of 25 ft^3/min. The units collect air particulates on 8- by 10-inch fiberglass filter media with a manufacturer's test specifications rating of 99.97% efficiency for particle sizes typically encountered during routine ambient air sampling (EG&G, 1990c).

Table 1.2 identifies the sampling equipment used for continuous measurement of airborne particulates. RFP samplers monitor ambient air for both total suspended particulates (TSP) and particulate matter (PM) with aerodynamic diameters of 10 microns or less. TSP and PM-10 samplers located near the east entrance to RFP are of particular importance because this location is unobscured by structures, is situated near a traffic zone, and is generally downwind from plant buildings and contaminated surfaces. Samplers are operated on a schedule of one day every sixth day. TSP is measured by the EPA-referenced, high-volume air sampling method (EPA, 1981).

Radionuclide Monitoring

The Radioactive Ambient Air Monitoring Program (RAAMP) collects particulate ambient air sampler information in order to track the dispersion of airborne radioactive materials from RFP into the surrounding environment as well as establish baseline concentrations. Samplers are assigned into one of three categories, depending upon their proximity to the main facilities area. Twenty-five onsite samplers are located within RFP and are concentrated near the main facilities area. Fourteen perimeter samplers border RFP along major highways to the north, east, south, and west. Fourteen community samplers are located in the metropolitan areas adjacent to RFP (EG&G, 1990c).

RAAMP monitor locations within and adjacent to the RFP operations area are shown in Figure 1-8. During 1988, sample filters were collected biweekly from twenty-three locations and analyzed for total long-lived alpha (TLL-α) radiation If the TLL-α activity for an ambient air sample exceeded the plant guide value of 10×10^{-15} μCi/ml (3.7×10^{-4} Bq/m^3), a specific plutonium analysis was performed on the collected sample. Filters from five of the twenty-three onsite samplers were routinely analyzed biweekly for plutonium (S-5 through S-9, Table 1.3). The mean concentrations of plutonium in ambient air at the five onsite stations during 1988 ranged from 0 149 x 10^{-15} to 0.710 x 10^{-15} $\mu Ci/m^3$ (5.51x10^{6} to 2 63 x 10^{-5}Bq/m^3) These concentrations represented less than four percent of the offsite Derived Concentration Guide (DCG) for plutonium in air. These five onsite samplers have historically exhibited the highest TLL-α activities for the RAAMP network (Rockwell, 1988).

During 1990, filters were also collected biweekly from all RFP samplers. Each biweekly onsite sampler filter was analyzed separately every month except in December. Filters collected in December were composited by location into one onsite sample Filters from perimeter and community samplers were collected biweekly, composited by location, and analyzed monthly for plutonium. Plutonium concentrations for onsite samplers during 1990 are provided in Table 1.4. Overall mean plutonium concentration for onsite samplers was 0.072 x 10^{-15} $\mu Ci/ml$ (2.7 x 10^{-6} Bq/m^3), or 0.36 percent of the offsite DCG for plutonium in air. By comparison, the overall mean plutonium concentration for perimeter samplers was 0.003 x 10^{-15} $\mu Ci/ml$ (1.1 x 10^{-7} Bq/m^3); the mean plutonium concentration for community samplers was 0.001 x 10^{-15} $\mu Ci/ml$ (3.7 x 10^{-8} Bq/m^3). These values are 0.013 percent and 0.005 percent, respectively, of the offsite DCG (EG&G, 19911).

Mean annual plutonium concentrations for 1986-1990 are shown in Figure 1-10 (onsite samplers) and Figure 1-11 (perimeter and community samplers). Onsite data were based on samplers S-5 through S-9; isotope-specific analyses were not reported for other onsite locations until 1990 (EG&G, 1990c).

Nonradiological Particulate Monitoring

Nonradiological particulate data collected by the RFP ambient air monitoring system are shown in Table 1-5 (EG&G, 1990c). The highest TSP value recorded in 1990 (24-hour sample) was 134 micrograms per cubic meter ($\mu g/m^3$) or 51 percent of the former TSP 24-hour primary standard. The annual geometric mean value was 31.4 $\mu g/m^3$ or 12 percent of former TSP primary annual geometric mean standard. The observed 24-hour maximum for the PM-10 sampler was 26 $\mu g/m^3$ or 17 percent of the primary 24-hour standard, and the annual arithmetic mean was 9.8 $\mu g/m^3$ or 20 percent of the primary annual arithmetic mean standard. Mean annual concentrations of particulates for onsite ambient TSP samplers (1986-1990) and PM-10 samplers (1988-1990) are shown in Figure 1-12 (EG&G, 1990c).

Air Data Usability

Air quality and meteorological monitoring programs at the RFP routinely emphasize meteorological parameters, total suspended particulates, and ambient air concentrations of particulate radionuclides While a record of area radionuclide concentrations and trends is important, the specific identity of contaminant sources and the conditions of typical and maximum atmospheric input from OU8 IHSS sites cannot be ascertained. Existing ambient air data are not sufficient for application in an IHSS site-specific human health risk assessment. Although there are air monitoring stations operating at or near OU8, they measure aggregate airborne particulate concentrations regardless of source. Furthermore, their operational schedule of the monitoring stations are currently independent of OU8 activities.

However, existing ambient monitoring of existing sites can provide important records of historical trends, establish current baseline conditions, and characterize major deviations in concentrations that might result in IHSS site-specific actions. It must be remembered that this data is not provided on a real-time basis, and uncertainty will always exist with these monitors concerning to multiple contaminant sources. As such, additional IHSS site-specific ambient monitoring will be required during OU8 Work Plan implementation This monitoring will be performed in conjunction with site worker safety monitoring

The routine RFP ambient air quality monitoring network does not gather data relevant to outdoor-contaminated surface-area source releases of volatile organic compounds (VOCs) A complete human health risk assessment for IHSS site VOCs will require additional information on the identity, emissions rate, dispersion, and ambient concentrations of VOCs originating from OU8. However, source concentrations of airborne VOCs to the air pathway (particularly with regards to individual OU8 IHSS sites) appear limited and would probably exist below the minimum detection levels of ambient detectors at all locations except the immediate vicinity of the source. As such, theoretical flux rates to the atmosphere can be derived from OU8 soil gas surveys. Coupled with dispersion models to support order-of-magnitude risk assessments, they can be used to determine VOCs should it be deemed necessary.

1.6.6 Ecology

A variety of plant life is found within RFP. The dominant vegetation found on the western portion of the site is disturbed mixed prairie, a mixture of both short and mid-length grasses. The eastern portion of RFP is generally highly disturbed through overgrazing, and short grasses are dominant. Sedges (*Carex nebraskensis*) and rushes (*Juncus arcticus*) are found in stream floodplains and wet valley-bottoms. Cottonwoods (*Populus sargentii*) and cattails (*Typha latifolia*) line many riparian areas.

Since acquisition of the buffer-zone property, vegetative recovery has occurred, as evidenced by the presence of disturbance-sensitive species such as big bluestem (*Andropogon gerardii*) and sideoats grama (*Bouteloua curtipendula*). One vegetative species, Ute Ladies'-tresses (*Spiranthes diluvialis*), has been identified as a threatened species on the Threatened and Endangered Species list. The habitat of this plant species has been identified in riparian areas of Colorado, specifically in riparian meadows in the City of Boulder (Boulder County) and along Clear Creek in Jefferson County. RFP is located on a flat that divides two drainages tributary to Boulder County and Clear Creek, although the plant has not been identified in these drainages to date. No vegetative stresses attributable to hazardous waste contamination have been identified.

Animal populations within RFP are representative of western prairie regions. The presence of a chain-link fence surrounding the production area effectively limits the occurrence of the most common large mammal, the mule deer (*Odocoileus hemionus*), to the buffer zone. The permanent population of *Odocoileus hemionus* is estimated to be 100 to 125. There are a number of small carnivores, such as the coyotes (*Canis latrans*), red fox (*Vulpes fulva*), striped skunk (*Mephitis*), and the long-tailed weasel (*Mustela frenata*). Small herbivores are common throughout the plant complex and buffer zone, including the pocket gopher (*Thomomys sp.*), white-tailed jackrabbit (*Lepus townsendii*), and the meadow vole (*Microtus pennsylvanicus*) (DOE, 1980).

Commonly observed birds include horned larks (*Eremophila alpestris*), western meadowlarks (*Sturnella neglecta*), mourning doves (*Zenaidura macroura*), vesper sparrows (*Pooectes gramineus*), western kingbirds (*Tyrannus vociferans*), black-billed magpies (*Pica*), American robins (*Turdus migratorius*), and yellow warblers (*Dendroica magnolia*) Mallards (*Anas platyrhynochos*) and other ducks (*Anas sp.*) often nest and rear young on several of the ponds. Killdeer (*Chradrius vociferus*) and red-winged black birds (*Agelaius phoeniceus*) are found in areas adjacent to the ponds. Birds of prey commonly seen in the area include marsh hawks (*Circus cyaneus*), red-tailed hawks (*Buteo jamaicensis*), ferruginous hawks (*Buteo regalis*), rough-legged hawks (*Buteo lagopus*), and great horned owls (*Bubo virginianus*) (DOE, 1980).

Rattlesnakes (*Crotalus sp.*) and bull snakes (*Pituophis melanoleucus*) are the most frequently appearing reptiles. Eastern yellow-bellied racers (*Coluber constrictor falviventris*) have also been seen. The eastern short-horned lizard (*Phrynosoma douglassi brevirostre*) has been reported on the site, but these and other lizards are not commonly seen. The western painted turtle (*Chrysemys picta*) and the western plains garter snake (*Thamnophis radix*) are found in and around many of the ponds (DOE, 1980).

Section 9 discusses in further detail the nature and extent of threatened and endangered species in and around RFP This section also provides a matrix with additional information regarding threatened and endangered species.

1.6.7 Surface Water Hydrology

Three Streams -- Rock Creek, Woman Creek, and Walnut Creek -- drain the RFP area and flow generally from west to east (Figure 1-13). Rock Creek, an intermittent stream, drains an area of the RFP buffer zone generally to the northwest of the RFP CA, flowing into Coal Creek offsite to the north. Coal Creek is located west and north of RFP and is joined by Rock Creek northeast of RFP. Coal Creek flows into Boulder Creek, then St. Vrain Creek, and eventually the South Platte River No runoff from the RFP CA drains into Rock Creek; therefore, Rock Creek is not impacted by the RFP activities.

Woman Creek, a perennial stream, originates to the west of RFP, drains the southern buffer zone area, and flows eastward into Pond C-1. The outflow from Pond C-1 flows offsite to the east in Woman Creek. The South Interceptor Ditch (SID), located between the RFP CA and Woman Creek, collects runoff from the southern part of RFP and diverts this to Pond C-2. Waters from Pond C-2 are pumped, treated, and discharged into Walnut Creek downstream of the eastern RFP boundary. Most of the remaining surface-water runoff in the Woman Creek drainage is outside of the SID. Drainage flows into Pond C-1 and then offsite to the east and in part into Mower Reservoir and primarily into Standley Lake.

Walnut Creek is formed by the combined flows from north Walnut Creek and South Walnut Creek, which drain the central and northern areas of RFP, respectively, along with an unnamed tributary draining a northern part of the RFP area. These three tributaries join in the buffer zone, and Walnut Creek flows towards the Great Western Reservoir to the east. However, Walnut Creek flows generally are diverted around Great Western Reservoir into Big Dry Creek through the Broomfield Diversion Ditch.

Figure 1-14 provides an overall schematic diagram of the RFP site area surface-water drainage system with the boundary of OU8 indicated. This Plant-site map indicates the layout of the different major drainageways and shows the location of the OU8 boundary in relation to these surface-water drainage systems.

Eight ditches convey water throughout the general RFP area: South Boulder Diversion Canal, Last Chance Ditch, Upper Church Ditch, McKay Ditch Bypass, Smart Ditch, Smart 2 Ditch, Mower Ditch, and Kinnear Ditch. The Upper Church Ditch, McKay Ditch Bypass, Kinnear Ditch, and Last Chance Ditch all divert water from Coal Creek to the east; the Smart Ditch diverts water from Rocky Flats Lake to the east, and the Smart 2 Ditch diverts water from the Smart Ditch to a Woman Creek tributary. The Mower Ditch diverts water from Woman Creek into Mower Reservoir. The South Boulder Diversion Canal is located west of RFP and is unlined in the vicinity of the RFP, except for a cement-lined 100-meter aqueduct that crosses the Woman Creek drainage. Other ditches around RFP are unlined and tend to lose water through seepage into the underlying subsurface materials.

In addition to the ditches described above, other surface-water management controls also are in operation at RFP. The West Interceptor Canal diverts runoff from the headwaters of North Walnut Creek via the McKay Ditch Bypass to Walnut Creek west of Indiana Street. In addition to ditches and canals, a series of detention ponds have been constructed to control the release of RFP discharges and to collect surface runoff.

The surface-water drainage areas from OU8 were analyzed using the information presented by Lee Wan and Associates (LWA) (1987), EG&G (1992i), and EG&G (1991d, 1991f). For the purposes of this analysis, the outer boundary of OU8 (EG&G, 1991e) was superimposed over the drainage-basin map (Figure 1-15) to assess which drainage areas are located wholly or partly within the OU, and to show localized drainage paths From this analysis, flow paths of the runoff leaving the OU were tracked through ditches, swales, culverts, storm sewer systems, and ponds to evaluate what areas located outside the OU8 boundary are receiving runoff originating from within the OU8 boundary

The major drainage basins that receive runoff from OU8 are as follows:

1) North Walnut Creek, and

2) South Walnut Creek.

The IHSSs located within each drainage basin have been listed on Table 1.6 and shown on Figure 1-15.

The North Walnut Creek basin collects drainage from the northern part of the RFP CA, including approximately 71 acres located within the OU8 boundary Runoff in the upper part normally bypasses Ponds A-1 and A-2 and is collected in Pond A-3. Figure 1-16 provides a schematic diagram of surface-water diversion structures at the A-series and B-series ponds Water may be diverted to Ponds A-1 and A-2, which are used exclusively for spill control (EG&G, 1991d) Pond A-4 is the terminal pond on North Walnut Creek and receives water released from Pond A-3 (EG&G, 1991f). Water from Pond A-4 is discharged to North Walnut Creek in accordance with the National Pollutant Discharge Elimination System (NPDES) permit for the Sewage Treatment Plant, the Federal Facilities Compliance Agreement (FFCA), and the Agreement in Principle (AIP) (EG&G, 1991f). North Walnut Creek is a perennial stream, whereas the tributary that carries the runoff from OU8 to North Walnut Creek is an intermittent stream, with flow occurring primarily after precipitation and snowmelt events.

The effects of OU8 on surface water and sediments cannot be easily separated from the effects of IHSSs in other OUs. The surface-water runoff leaving OU8 flows north to North Walnut Creek. Upon reaching North Walnut Creek, the runoff enters OU6 which encompasses the A-series ponds. Other OUs having IHSSs also located within the OU8 boundary are OU4, OU6, OU9, OU10, OU13, OU14, and OU16. Table 1.7 provides a listing of each operable unit and the associated IHSSs which are located within the boundary of OU8 (DOE, 1991) The OU8 IHSSs which are located within the North Walnut Creek drainage basin are listed along with the type of contaminant reportedly released and which monitoring sites are located nearest upstream and downstream of that IHSS. The surface water and sediment sampling sites are shown on Figure 1-17

South Walnut Creek begins on Rocky Flats property and receives runoff from the site, including approximately 78 acres located within the OU8 boundary. This basin can be further divided into upper South Walnut Creek and lower South Walnut Creek drainage basins (LWA, 1987) (Figure 1-15) Lower South Walnut Creek is an intermittent stream and upper South Walnut Creek is a perennial stream.

The upper South Walnut Creek drainage basin receives storm runoff from approximately 69 acres within OU8. This runoff flows through a storm sewer system and is discharged into a "natural" drainageway of South Walnut Creek near the southeast corner of the Protected Area (PA). This drainageway flows into a storm sewer system which discharges on the east side of the PA Area back into the natural channel. This channel then drains east to a culvert system under the Northeast Perimeter Road and into a diversion structure located just upstream from Pond B-1 (Figure 1-16). This runoff is normally diverted around Ponds B-1, B-2, and B-3 through a bypass line to Ponds B-4, although it may be diverted into Pond B-1 (Figure 1-16) Pond B-4 has limited storage capacity and generally passes water directly to Pond B-5 (EG&G, 1991f).

Historically, ponds B-1 and B-2 have been used as spill-control ponds to receive potentially contaminated surface water from the South Walnut Creek basin (EG&G, 1991d). The goal is to keep water levels in Pond B-1 and B-2 low in order to maintain capacity for spill control and dam safety. Pond B-3 collects effluent discharged via a pipeline from the sewage treatment plant. Water in Pond B-3 is discharged in accordance with provisions of the RFP NPDES permit to Pond B-4 and thence to Pond B-5

Pond B-5 is the terminal pond on South Walnut Creek. Prior to 1989, water from Pond B-5 was discharged through a valve directly into South Walnut Creek. From early 1989 until late 1990, the water was treated prior to discharge. Beginning in late 1990, excess water in Pond B-5 has been transferred by a pipeline to Pond A-4, where it may be treated if necessary and discharged to Walnut Creek according to the NPDES permit, the FFCA, and the AIP (EG&G, 1991f).

The surface-water runoff leaving OU8 flows east into OU6, which encompasses the B-series ponds located along South Walnut Creek (Figure 1-16) The OU8 IHSSs which are located within the upper South Walnut Creek sub-basin are listed in Table 1.8 along with the type of contaminant reportedly released and which monitoring sites are located nearest upstream and downstream. The surface water and sediment sampling sites are shown on Figure 1-17.

The lower South Walnut Creek drainage basin receives storm runoff from approximately 9 acres within OU8. The primary drainage structure of this drainage basin is the manmade drainage ditch along the south side of Central Avenue. Runoff from this basin is conveyed to a diversion structure located on the west side of the Northeast Perimeter Road. This runoff can be diverted north to the Upper South Walnut Creek drainage subsystem or east to south Walnut Creek between Ponds B-4 and B-5 (Figure 1-16)

1 6.8 Soils

At OU8 three soil units and their distribution have been described by the Soil Conservation Service (SCS) and are shown on Figure 1-18 (SCS, 1983). The soils consist of the Flatiron series, located on Rocky Flats Alluvium, Nederland series, commonly located on the upper slopes flanking Rocky Flats Alluvium; and Denver-Kutch-Midway series, located on slopes flanking the previous soils The dominant soil in the OU8 area is the Flatiron series These soils are very cobbly sandy loams that exhibit a slow infiltration rate and are typically located on slopes of 0 to 3 percent. The next most abundant soil in the area is the Denver-Kutch-Midway series which is restricted to the northern area and the southeastern portion of OU8 These soils are clay loams. They exhibit a slow infiltration rate and develop on claystones where slopes are 9 to 25 percent. Limited occurrences of Nederland series soils are present in the northwestern corner and the southeastern corner of OU8. The Nederland soils developed adjacent to the Flatiron series along the periphery of the Rocky Flats Alluvium where slopes are 15 to 50 percent. The Nederland soils exhibit a moderate infiltration rate. At the RFP, all three soils are partly obscured by fill materials, gravel, or buildings and other structures No soils are distinguished in the core data given in Appendix C-7

1 6.9 Quaternary Geology

The RFP is located on gravelly alluvium that covers an eastward sloping pediment shown on Figure 1-19. The surficial deposits covering the pediment in the immediate vicinity of the RFP comprise the Rocky Flats Alluvium. The alluvium is Quaternary in age and was deposited as a broad, flat, eastward-sloping alluvial fan with its apex near the mouth of Coal Creek Canyon, three miles west of the RFP. Lithologically, the alluvium is composed of poorly-to moderately-sorted, poorly-stratified cobbles, gravel, sand, silt, and clay. The coarse clastic materials were derived primarily from Front Range provenance areas which are composed of Precambrian crystalline metaquartzites, metabasalts, pelitic schists, and younger granitoids of the Boulder Creek Granite and Silver Plume Granite.

The Rocky Flats Alluvium underlies nearly all building structures at the RFP, provided it has not been removed and replaced with artificial fill materials. Within the RFP, thickness of the alluvium ranges up to 100 feet or is absent where it has been removed by erosion and downcutting of Walnut Creek and Woman Creeks. From west to east across the alluvial fan approximately 3 4 miles, where the RFP is situated, the depositional surface declines approximately 300 feet in elevation, a slope of 88 feet per mile.

Based upon mapping compiled by Hurr (1976) and EG&G (1992f), nearly all of the CA at the RFP is underlain by Rocky Flats Alluvium These sediments are covered by thin soils, colluvium, artificial fill materials, and RFP structures In this area, the thickness of the Rocky Flats Alluvium ranges from slightly more than 50 feet to less than 10 feet. Appendix C-7 lists the thickness of Rocky Flats Alluvium as intersected in core within and immediately-adjacent to OU8.

Geologic materials native to the site (Rocky Flats Alluvium) and imported materials have been used as fill at the RFP for road grade and berm construction, recontouring peripheral to structures, local valley fill, fill of topographic lows, and for construction of surface impoundments Artificial fill thicknesses are described from drill intercepts and are tabulated in Appendix C-7. Crushed rock has been used for landscaping and levelling at the site Throughout most of the OU8 area, the land surface is covered with pavement and imported gravel, in addition to buildings and disturbed ground.

Locally, colluvial deposits are present on steeper slopes flanking stream drainages that extend across the RFP. These deposits are derived from Rocky Flats Alluvium and that of bedrock, the Arapahoe Formation. Throughout the steeper slopes and valleys at the RFP, most bedrock is concealed beneath soil-draped colluvial material. Occurrence of these materials is limited by plant-site buildings and pavement, but exists in the southeastern corner of the OU8 as shown on Figure 1-20. Thickness and occurrence of colluvium is identified in the core intercept data furnished in Appendix C-7. Colluvium from drill core samples containing constituents of alluvium may be difficult to distinguish from the Quaternary age Rocky Flats Alluvium.

Along the bottoms of the stream valleys, Quaternary age, valley-fill alluvium is deposited and exhibits minor linear wetlands on these alluvial materials (EG&G, 1990a).

It is suggested that the top of the bedrock surface reflects the remnants of the pre-Wisconsin age pediment as well as the effects of Recent stream incisement (Figure 1-21) (EG&G, 1991h). This figure shows the configuration of the pre-Wisconsin age surface as based upon site borehole lithologic logs and it also depicts the pediment areas lost by subsequent erosion of present-day streams Recent headward erosion has removed Rocky Flats Alluvium along the drainages of North Walnut, South Walnut, and Woman Creeks. Consequently the underlying bedrock is locally exposed in the central and northern drainages (EG&G, 1992f and Rockwell, 1988). Contained locally within the underlying bedrock is the Cretaceous Arapahoe Formation No. 1 Sandstone. This sandstone, covered by Quaternary Colluvium and older Quaternary Rocky Flats Alluvium, subcrops or may be partly eroded by South Walnut Creek in the southeast part of OU8.

1.6 10 Cretaceous Geology

Thin soils, colluvium, and extensive alluvium obscure much of the surficial (bedrock) geology at the RFP. At the RFP, core drilling and logging have been used extensively to characterize the subsurface. The geological description of OU8 area was derived mainly from the Geological Characterization Report (EG&G, 1991h) and logs of boreholes and wells. Other useful references include these geologic maps Plate 1 (Hurr, 1976); Plate E-6 (Rockwell, 1988); and Plate 1

(EG&G, 1992f) The surficial geology for the RFP and vicinity is shown on Figure 1-19 The surficial geology for OU8 specifically is shown on Figure 1-20, including well and borehole locations Data for selected wells and borehole logs within and immediately adjacent to OU8 are given in Appendix C-7 Hydrogeologic data presented for these 75 wells and 18 boreholes includes location, type and thickness of surficial materials, elevation to the top of bedrock, its lithology, and screened interval of wells. Well completion, hydrologic, and geologic information for these wells and boreholes are contained in Appendix C-8 and Appendix D

Figure 1-22 is a generalized stratigraphic section showing bedrock units exposed near the east edge of the Front Range in the Golden-Morrison area, a few miles south of the RFP. Figure 1-23 is a generalized stratigraphic section of the youngest units at the RFP. These units dip generally eastward, as shown in Figure 1-19, and are locally exposed at the surface and occur throughout the subsurface beneath the RFP.

The upper Cretaceous rocks, which unconformably underlie the surficial material at the RFP, consist dominantly of claystones and silty claystones with subordinate sandstones. According to the Geologic Characterization Report for RFP (EG&G, 1991h), the youngest Cretaceous unit, the Arapahoe Formation, is 150 feet thick beneath the central portion of the RFP. The uppermost sandstone unit of the Arapahoe Formation is there referred to as the No. 1 Sandstone. However, a final report resulting from recent field mapping evaluations depicts the overall Arapahoe Formation as less than 50 feet thick in the central portion of the RFP area (EG&G, 1992f). Attempts to resolve this controversy are in progress; however in either case, the shallow Arapahoe Formation sandstone beneath the pre-Wisconsin age unconformity is of concern as a potential contaminant pathway.

Most of the Cretaceous age Arapahoe and immediately-underlying older sandstones are very fine to medium grained, poorly to moderately sorted, subangular to subrounded, silty, and clayey. Some coarse-grained conglomeratic sandstone have been identified in the No. 1 Sandstone.

Generally, all upper Cretaceous sandstones are laterally discontinuous and have lenticular geometries The Arapahoe Formation No 1 Sandstone has been interpreted as a meandering channel, point bar, and overbank deposit (EG&G, 1991h).

The Laramie Formation conformably underlies the Arapahoe and is approximately 800 feet thick at the RFP (Weimer, 1973). At present, these formation contacts are not clearly defined on site or in drill core. The Laramie Formation is divided into two intervals. a lower unit (about 300 feet thick) of sandstone, siltstone, and claystone with coal layers; and an upper claystone unit (Weimer, 1973 and EG&G, 1991g) The sandstones are fine to coarse grained, poorly sorted, subangular, and silty. The upper interval is about 500 feet thick at the RFP, consisting of light to medium gray kaolinitic claystones with some dark grey to black carbonaceous claystones (EG&G, 1991h) The Laramie Formation is interpreted as having been deposited in a coastal or transitional marine environment.

There are 13 wells and boreholes within and immediately adjacent to OU8 which have delineated the No. 1 Sandstone subcropping at the Arapahoe Formation - Rocky Flats Alluvium unconformity. Listings of the lithologies which occurred in these wells is presented in Appendix C-7. In general, the No 1 Sandstone is very fine grained to fine grained, well sorted, sub-angular to sub-rounded, moderately friable, highly weathered, and heavily iron stained The thickness of subcropping sandstone units ranges from 0.5 feet in well 2086 to greater than 11.5 feet in well 3186. Usually, the sandstone unit is underlain and flanked by finer units such as siltstone or claystone. The No. 1 Sandstone is potentially the most significant hydrogeologic pathway in the bedrock for contaminant migration where it is in hydraulic communication with the water table aquifer at the RFP.

Fining upward clastic sequences indicate a decrease of sediment transport energy relative to fluvial transport energy genetically associated with underlying, adjacent layers. These lithologic characteristics may be used to suggest fluvial channel (sandstone) proximity beneath a borehole partially penetrating the entire clastic sequence Both interpretations also observe that the No. 1 Sandstone consists of more than one fining upward sequence The Geological Characterization Report states that a minimum of three fining upward sequences are recognized where penetration of the No 1 Sandstone is complete. Fining upward sequences and presence of the No 1 Sandstone for wells with subcropping sandstone units are listed in Appendix C-9 The lithologic analysis has been interpreted and results in two separate fluvial depositional models.

Figures 1-24 and 1-25 are isopach maps based on the Geologic Characterization Report, which presents two interpretations for the No 1 Sandstone in the OU8 area. These maps are highly interpretative because subsurface control is limited. Interpretation 1 suggests a single, continuous north-south meandering channel system. Channel and point bar deposits are both recognized (Figure 1-24); however, channel-fill deposits are dominant. Interpretation 2 (Figure 1-25) depicts an east-northeast trending channel system containing laterally migrated channel and point bar deposits.

Figures 1-26 through 1-30 present five geological cross sections beneath OU8. Sections A-A' and B-B' are generally oriented west to east while sections C-C', D-D', and E-E' are oriented north to south across the area of OU8 In order to graphically display subsurface geologic and hydrologic data previously collected at wells along these lines of section, the vertical scale has been exaggerated as indicated. Accordingly, the surfaces intersected, such as topography, water tables, bedrock unconformity, and formation boundaries, are proportionately inclined greater than actual slopes interpolated to the next adjacent well providing correlative conditions. Along the ground surface profile of each section, the scaled position of each IHSS intersected or in close proximity to the section is also indicated, as are intersections or ties to other cross sections. Well screen intervals and the extremes of water level over a one-year period are also indicated. Closed triangle symbols indicate the measured water level position extremes for the uppermost hydrostratigraphic unit (HSU) (the uppermost HSU is referred to as HSU1) which includes the alluvium and the hydrologically connected No. 1 Sandstone of the Arapahoe Formation. Open triangles indicate other water levels relative to the deeper piezometric levels within interbedded claystones, siltstones, and thin sandstones which have no direct hydrologic connection to HSU1.

Interpretation 1 for Arapahoe Formation No. 1 Sandstone beneath OU8 is the presence of three segments of a single, meandering subsurface channel crossing beneath OU8 as previously described Cross Sections A-A', B-B', D-D', and E-E' (Figures 1-26, 1-27, 1-29, and 1-30) show an idealized conceptual model for this interpretation Cross Section B-B' shows three intersections with a single channel meander. The sandstone is depicted as subcropping in the central channel, but the lateral extent of the eastern channel and the lateral and vertical extent of the western channels are not clearly defined. The thickest No. 1 Sandstone interval (21 feet) was intersected in well P209189 as shown in Cross Sections A-A' and D-D'. If Interpretation 1 is accurate, groundwater flow confined by flanking claystones would occur parallel to the sandstone channel axis, in a north-south direction as shown in Figure 1-24.

Interpretation 2 for Arapahoe Formation No. 1 Sandstone beneath OU8 suggests the presence of two sandstone channels in the southeastern and northwestern portions of OU8. The thickest No 1 Sandstone unit, found in well P209189, is in the northern sandstone channel Other significant occurrences of the subcropping No. 1 Sandstone are indicated at well P209389 located in the northern channel and at wells BH31-87, BH32-87, and BH34-87, which are located in the southern channel and the southeast portion of OU8 Cross sections A-A', B-B', D-D', and E-E' show an interpretation of these two sandstone channels. If Interpretation 2 is accurate, groundwater flow, confined by flanking claystones, would be eastward in sandstone channel trends as shown in Figure 1-25.

Under this Work Plan, the RI implementation within OU8 will entail additional subsurface lithologic characterization concurrent with well installation. Samples of cored materials will be evaluated to support or refute Interpretation 1 or 2. Ongoing subsurface investigations peripheral to OU8 will also help expand and support the interpolated positions and extrapolated channel trends of the No 1 Sandstone of the Arapahoe Formation.

1.6.11 Structural Geology

Structurally, the RFP is on the western flank of the Denver Basin, approximately four miles east of steeply dipping strata on the east flank of the Front Range uplift. The generalized west to east geologic structure beneath the RFP is shown on Figure 1-31. The most prominent feature is a monoclinal fold which strikes approximately north-south. Bedrock dips steeply eastward in the western portion of the RFP, as reflected by the 50 degree dip of the Fox Hills sandstone and Laramie claystone. Beneath the CA, the bedrock flattens to a dip of no more than 1 to 2 degrees.

1.6.12 Hydrogeology

The RFP is situated in a regional groundwater recharge area. The groundwater system is dynamic, that is, rapid changes in water table elevations occur in response to short-term or incident precipitation events and variations in recharge. Generally water levels are highest in spring and early summer and lowest during the winter months.

Characterization of the groundwater flow regime in OU8 is based on boring logs, water level measurements, and well completion data from piezometers and monitoring wells. There are 54 wells and piezometers within the boundary of OU8 (Appendix C-9). Water levels are measured monthly in piezometers; water levels are measured monthly and groundwater samples are collected quarterly in groundwater monitoring wells. All of the wells and piezometers are either RCRA Regulatory wells or Non-Regulatory Characterization wells with the exception of well 4386, which is a CERCLA Characterization well (EG&G, 1991c).

1.6 12 1 Hydrostratigraphic Units

Hydrostratigraphic units that exist in the strata beneath the Rocky Flats site in the surficial materials and the underlying Cretaceous bedrock are shown in Figure 1-31. The uppermost hydrostratigraphic unit, HSU1, is a water table aquifer which occurs primarily in unconsolidated surficial material. These materials include the Rocky Flats Alluvium, present on broad topographic highs; colluvium along valley slopes; and the valley fill alluvium present in modern stream drainages. Generally, groundwater within the water table aquifer flows to the east along the contact of the surficial material with the Arapahoe Formation claystones. The claystones effectively constrain much of the flow within the water table aquifer to the surficial material above the bedrock unconformity. Interpretation of borehole logs indicates that locally a hydraulic connection exists between the Arapahoe Formation No. 1 Sandstone and the surficial materials (Appendix C-7), so that within limited areas the sandstones are part of HSU1.

The Arapahoe Formation No. 1 Sandstone occurs locally within HSU1 in some areas of OU8 where it crops out or directly underlies the surficial material, and exists in hydraulic connection with these surficial materials (Figures 1-24, 1-25, 1-32, and 1-33). Generally, the groundwater flows within the water-bearing materials and along the contact of the claystones and silty claystones of the Arapahoe Formation from west to east, with minor diversions along drainages and off paleotopographic highs (pre-Wisconsin erosional surfaces).

In the western part of the RFP where the thickness of the surficial material is greatest, the depth to the water table is 50 to 70 feet below the surface. Although the water table depth is variable, it becomes shallower from west to east as the surficial material thins. In the stream drainages, seeps are common at the base of the Rocky Flats Alluvium and where individual Arapahoe Formation sandstones are exposed (EG&G, 1991h) HSU1 water levels in OU8 are generally lower in wells where the surficial material is directly underlain by Arapahoe Formation sandstone (Figures 1-26 and 1-29) than in nearby wells where the surficial material is underlain by

Arapahoe Formation claystone. HSU1 water levels ranged from less than 2 feet to 22 feet below ground surface in April, 1992, a month of historic high water levels at RFP The saturated thickness may decrease during the winter months and some wells are seasonally dry in the OU8 area (Appendix C-8, Figures 1-27 and 1-29)

Lower hydrostratigraphic units at the RFP include those sandstones stratigraphically below the surficial material which exist under confined conditions. The confining layers for the sandstones are claystones and silty claystones. There are numerous bedrock monitoring wells in the OU8 area. In places where the uppermost sandstone is separated from the surficial materials by claystones and silty claystones, it may exist as a confined aquifer (Appendix C-7) Water levels measured in bedrock wells in other areas of the RFP indicate a strong downward gradient (EG&G, 1991h) This is conformable with the fact that the RFP site is on a topographic high and is within a regional recharge area.

The Laramie and Fox Hills aquifer crops out at the west end of the RFP and dips at 45 to 50 degrees to the east. Gradually the dip decreases to less than two degrees beneath the central part of the RFP where the older Laramie and Fox Hills formations are separated from the overlying Arapahoe Formation (Hurr, 1976) (EG&G, 1991h). The claystone within the lower Arapahoe and upper Laramie Formations are of low hydraulic conductivity and would tend to retard downward groundwater movement to the Laramie and Fox Hills aquifer.

1.6.12.2 Recharge and Discharge

Groundwater recharge occurs as infiltration of precipitation to confined aquifers where bedrock crops out in the western portion of the RFP along the west limb of the monoclinal fold, and also to the unconfined saturated zone through unconsolidated surficial materials and into subcropping permeable bedrock throughout the RFP area (Figure 1-19) Recharge also occurs as a result of infiltration of surface water from streams, ditches, and ponds. At the local level, there are areas of discharge as well as recharge. Baseflow of some of the perennial streams is sustained by runoff (drainage) or groundwater discharge Surface water runoff and groundwater migrating via building footing drains or within the surficial materials and underlying permeable bedrock (Arapahoe Formation sandstones) discharge at drain outfalls or seeps along side slopes in the valleys and become surface water or evaporates.

Within OU8, there are areas of recharge and discharge. As a result of extensive paving and building construction at OU8, it is estimated that less than 40 percent of the natural surface materials are exposed directly to incident precipitation. The majority of the precipitation runoff is diverted to trenches, culverts, and stormwater drains to be conveyed to two surface drainages. One unnamed surface drainage within the northwestern portion of OU8 (Figure 1-14) receives baseflow contribution from groundwater discharge most of the year, as evidenced by marshes along its extent. The other drainage is South Walnut Creek, an intermittent stream, gaining during high precipitation in spring and early summer, while losing during the low precipitation of late summer and fall. Recharge to the groundwater system also occurs as a result of groundwater flow from upgradient areas west of OU8 and possibly as seepage from ponds and ditches in the area.

1.6.12.3 Hydraulic Conductivities

No conclusive data are available for the recent alluvial and colluvial deposits. An aquifer test conducted near Woman Creek in OU1 indicates a relatively high hydraulic conductivity of 1.8 x 10^{-2} centimeters per second (cm/sec) for the Valley Fill Alluvium (Doty & Associates, 1992b). Aquifer tests performed recently in the OU2 area provide values of hydraulic conductivity for the Rocky Flats Alluvium and the Arapahoe No 1 Formation Sandstone (EG&G, 1992h). Pumping tests at two sites in the Rocky Flats Alluvium yielded values of 5.5 x 10^{-5} to 1.4 x 10^{-4} cm/sec and 7.1 x 10^{-4} to 3.1 x 10^{-3} cm/sec. A pumping test conducted in sandstones and silty sandstones of the Arapahoe No. 1 Formation Sandstone yielded values of 4.1 x 10^{-4} to 4.6 x 10^{-4}

cm/sec while a slug test performed in clayey sandstones of the Arapahoe No. 1 Sandstone at another site provided a value of 4 88 x 10^{-6} cm/sec

Packer tests performed in 1986 and 1989 provide additional estimates of hydraulic conductivity for the Rocky Flats Alluvium and the Arapahoe Formation Sandstones (EG&G, 1991h). The Rocky Flats Alluvium of HSU1 has a hydraulic conductivity of roughly 6 x 10^{-5} cm/sec in Well B400189 This value is comparable to the hydraulic conductivity of 8 x 10^{-5} cm/sec for the highly-weathered and unconsolidated subcropping Arapahoe Sandstone No. 1 which also forms a part of HSU1 in Well 386. Both of these values are much greater than the hydraulic conductivities of the Arapahoe claystones which are approximately 1 x 10^{-7} to 1 x 10^{-8} cm/sec for both weathered and unweathered claystone (EG&G, 1991d) On a regional scale throughout the Denver basin, horizontal hydraulic conductivities calculated from aquifer tests and laboratory measurements of the water-yielding materials in the Arapahoe aquifer range from 7.1 x 10^{-7} to 3.5 x 10^{-3} cm/sec (Robson, 1983) Sandstones stratigraphically lower than the Arapahoe Formation No. 1 Sandstone have hydraulic conductivities of approximately 1 x 10^{-6} cm/sec. This value is intermediate to that of the hydrostratigraphic units in the Rocky Flats Alluvium and weathered subcropping Arapahoe sandstones (1 x 10^{-5} cm/sec) and the Arapahoe claystones (1 x 10^{-7} to 1 x 10^{-8} cm/sec) (EG&G, 1991c) Information on hydraulic conductivities is presented in Table 1-9.

1.6 12 4 Water Level Maps

Monthly water levels measured in OU8 wells and the surrounding area over the last 3 to 6 years indicate that the overall saturated thickness of HSU1 was greatest in April 1992 (Appendices C-7 and C-8). Figure 1-32 is a high water level map of HSU1 for water levels measured in April 1992. This figure indicates that the dominant direction of groundwater flow is to the east, with major diversion of flow into two drainages, an unnamed surface drainage in the northwestern portion of OU8 and South Walnut Creek.

The same water level data also indicates that the saturated thickness of HSU1 in OU8 was the least in January 1991 (Appendix C-8) A low water level map of HSU1 is presented as Figure 1-33 Overall the flow patterns are the same as that for the high water levels However, a number of wells are dry in the central area of OU8, a present-day topographic high and also a paleotopographic high (Figure 1-21) Although the low water level map cannot reflect localized patterns, groundwater flow is expected to be patchy and governed by paleotopography on a much smaller scale.

TABLE 1.1

Current and Projected Population in the Vicinity of the Rocky Flats Plant

	Segment							
Sector	B	C	D	E	F	G	H	Sum
Year: 1989								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	5	13	0	0	0	17	0	35
4	0	22	0	283	46	50	215	616
5	300	13	25	3,671	477	578	2,355	7,419
SUM	305	48	25	3,954	523	645	2,570	8,070
Year: 2000								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	5	13	0	0	0	17	0	35
4	0	214	7	472	96	50	630	1,469
5	1,289	566	25	4,372	542	1,259	6,457	14,510
SUM	1,294	793	32	4,844	638	1,326	7,087	16,014
Year: 2010								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	5	13	0	0	0	17	0	35
4	0	389	14	644	142	50	1,007	2,246
5	2,189	1,069	25	5,009	601	1,879	10,186	20,958
SUM	2,194	1,471	39	5,653	743	1,946	11,193	23,239

Source. DOE (1991)

Table 1.2

Ambient Air Monitoring Detection Methods

Parameter	Detection Methods
Particulate Matter less than 10 micrometers in diameter (PM-10)	Wedding PM-10 Sampler
Total Suspended Particulates (TSP)	Reference Method (Hi-Volume) 24-Hour sampling (6th-day)

Table 1.3

Plutonium-239 and -240 Activity Concentrations in Onsite Ambient Air at Selected Locations During 1988[a]

Station	Number of Analyses	Volume (X 1000m³)[d]	Concentration[b] (x 10^{-15} µCi/ml)[c] C_{min}	C_{max}	C_{mean}	Standard Deviation (C_{mean})	Percent of DCG[e] (C_{mean})
S-5	25	331	0.054	1.389	0.389	0.357	1.95
S-6	26	344	0.027	0.460	0.149	0.111	0.75
S-7	26	328	0.045	1.171	0.515	0.369	2.58
S-8	26	418	0.114	1.246	0.710	0.366	3.55
S-9	26	376	0.205	1.179	0.641	0.286	3.21
S-6[f]	1	11	NA[g]	NA	0.059	NA	0.30
S-7	1	12	NA	NA	0.664	NA	3.32
S-8	1	17	NA	NA	2.129	NA	10.65
S-9	1	12	NA	NA	1.281	NA	6.41

a. Air-sampling stations S-5, S-6, S-7, S-8, and S-9 are located in areas where the potential for elevated airborne radioactivity is greatest.

b. Concentrations reflect monthly composites of biweekly station concentrations C_{min} = minimum composited concentration, C_{max} = maximum composited concentration, C_{mean} = mean composited concentration.

c. To obtain the proper concentration, multiply the numbers listed in the table by 1 x 10^{-15} µCi/ml. For example, the mean concentration at S-5 was 0.389 x 10^{-15} µCi/ml

d. To obtain the proper volume, multiply the numbers listed in the table by 1000 m³ For example, the air volume sampled at S-5 was 331,000 m³

e. The interim standard calculated Derived Concentration Guide (DCG) for inhalation of class W plutonium by members of the public are applicable for offsite locations All locations in this table are on Rocky Flats Plant property The DCGs for the public are presented here for comparison purposes only

f. Samples from stations S-6 (taken 8/9/88 to 8/23/88), S-7 (taken 4/19/88 to 5/3/88), S-8 (taken 11/29/88 to 12/13/88), and S-9 (taken 8/23/88 to 9/6/88) exceeded the screening guide to 10 x 10^{-15} µCi/ml total long-lived alpha activity Specific plutonium analyses were performed on these samples. The results of these analyses are included for completeness

g. NA = Not applicable

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Table 1.4

Onsite Ambient Air Sampler Plutonium Concentrations (1990[a,b])

Station	Number of Samples	Concentration (x 10^{-15} μCi/ml)[c] Cminimum	C maximum	C mean	Standard Deviation (C standard)	Percent of DCG[d] (C mean)
S-1	21	0 000	3 057	0 948	0 892	4 740
S-2	13	0 003	0 024	0.007	0 007	0 037
S-3	16	0 000	0 010	0 003	0 001	0 014
S-4	17	0 001	0 181	0 022	0 050	0 110
S-5	24	0 004	0 453	0 099	0 123	0 496
S-6	24	0 013	0 482	0 127	0 144	0 637
S-7	24	0 010	0 670	0 118	0 180	0.588
S-8	25	0 024	0 108	0 061	0 033	0.305
S-9	24	0 033	0.328	0 107	0 094	0.535
S-10	17	0 002	0 016	0 006	0 004	0 028
S-11	17	0 000	0 008	0 005	0 003	0 024
S-12	17	0 002	0 023	0 013	0 007	0 063
S-13	17	0 001	0 008	0 004	0 003	0 018
S-14	17	0 000	0 006	0 002	0 002	0 011
S-15*	15	-0 001	0 028	0 004	0.008	0 021
S-16	17	-0 001	0 005	0 002	0 002	0 011
S-17	17	0 005	0 022	0 011	0 005	0 053
S-18*	16	0 011	0 069	0 035	0 020	0 177
S-19	17	0 010	0 092	0 028	0 023	0 142
S-20	17	0 004	0 033	0 016	0 008	0 080
S-21	17	0 004	0 018	0 009	0 005	0 045
S-22	17	0 001	0 009	0 004	0 002	0 020
S-23	16	0 001	0 006	0 003	0 002	0 015
S-24	17	-0 002	0 010	0 002	0 003	0 012
S-8B*	13	0 051	0.356	0 161	0 123	0 806
Overall	452	-0 002	3 057	0 072	0 070	0.360

a Data provided in this table are based on various periods of sampling The locations not marked with an asterisk are calculated on a 12-month basis. The other locations are calculated using less than 12 months of data due to mechanical malfunctions, incomplete laboratory analyses, or the installation of a new sampler (S-8B) that has not been in service for a complete year.

b Isotope-specific analyses were reported only for locations S-5 through S-9 before 1990. These five samplers are the only onsite locations included in the 5-year trending portion of this report.

c Concentrations reflect monthly composites of biweekly station concentrations; C minimum - minimum composited concentration, C maximum = maximum composited concentration; C mean = mean composited concentration.

d. The DOE Derived Concentration Guide (DCG) for inhalation of class W plutonium by members of the public is 20 x 10^{-15} μCi/ml Protection standards for members of the public are applicable for offsite locations. All locations in this table are on RFP property. DCGs for the public are presented here for comparison purposes only

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Table 1.5

Ambient Air Quality Data for Nonradioactive Particulates

Total Suspended Particulates	μg/m³
Total Number of Samples[a]	56 0
Total Number of Samples[b]	59 0
Annual Geometric Mean[a]	31 4
Annual Geometric Mean[b]	27.7
Standard Deviation[a]	20.3
Standard Deviation[b]	18.2
Observed 24-Hour Maximum[a]	134 4
Observed 24-Hour Maximum[b]	119.0
Second Highest Maximum[a]	74.0
Second Highest Maximum[b]	69.0
Lowest Observed Value[a]	8.0
Lowest Observed Value[b]	2.9
Respirable Particulates (PM-10)	
Total Number of Samples[c]	45.0
Total Number of Samples[d]	49 0
Annual Arithmetic Mean[c]	9.8
Annual Arithmetic Mean[d]	11.2
Observed 24-Hour Maximum[c]	26.0
Observed 24-Hour Maximum[d]	29.7
Second Highest Maximum[c]	19.0
Second Highest Maximum[d]	26.0

a Primary ambient air TSP particulate sampler; reporting unit.
b Collocated duplicate TSP sampler.
c. Primary ambient air PM-10 sampler.
d. Collocated duplicate PM-10 sampler

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Table 1.6

Relationship of OU8 IHSSs to Surface Water Drainage Basins

I	Drainage Basin	IHSSs	
	A. North Walnut Creek	118.1	150.3
		135	150.6
		137	150.7
		138	150.8
		139.1 (N & S)	151
		139.2	163.1
		144	163.2
		150.1	172
		150.2	188
	B. Upper South Walnut Creek	118.2	172
		123.1	173
		150.4	184
		150.7	

Table 1.7

Relationship of Other OUs and IHSS's[1] to OU8 and Drainage Basins at Rocky Flats Plant, Colorado

OU Number	IHSS Number	Drainage Basin
OU4	101	North Walnut Creek
OU6[2]	143	North Walnut Creek
OU9[1]	121	North Walnut Creek and lower South Walnut Creek
	123.2 (150 5)	
	124 1-124 3	North Walnut Creek
	125	North Walnut Creek
	126	North Walnut Creek
	127	North Walnut Creek
	132	North Walnut Creek
	146.1-146.6	North Walnut Creek
	147 1	upper South Walnut Creek
	149	North Walnut Creek
	159	North Walnut Creek and lower South Walnut Creek
	215	North Walnut Creek
OU10	175	upper South Walnut Creek
	176	North Walnut Creek and upper South Walnut Creek
	206	North Walnut Creek
	210	upper South Walnut Creek
OU13	117.1	North Walnut Creek and upper South Walnut Creek
	117 2	upper South Walnut Creek
	128[3]	North Walnut Creek
	137[3]	North Walnut Creek
	158	North Walnut Creek and upper South Walnut Creek
	171[3]	North Walnut Creek
	186	North Walnut Creek
	190	upper South Walnut Creek
OU14	156 1[3]	North Walnut Creek
	162	North Walnut Creek and upper South Walnut Creek
OU16	185	upper South Walnut Creek
	192	upper South Walnut Creek
	194	upper South Walnut Creek
	197	North Walnut Creek and upper South Walnut Creek

1) Location of IHSSs reflect assignment as per CDH letter dated April 21, 1992
2) Located downstream of OU8
3) Located within the area that drains onto OU8 Not located within the OU8 boundary

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TABLE 1.8

Description of IHSS Contaminants and Affected Surface-Water Drainage Basins[1]

Drainage Basin/IHSS	Released Contaminants[2)]	Type[3)]	Monitoring Site[4)] Downstream Surface	Downstream Sediment	Upstream Surface	Upstream Sediment
I NORTH WALNUT CREEK						
•118 1 Solvent Spill, W End of Bldg 730	Carbon Tetrachloride Trichloroethelyene	D	SW102	SED120	None	None
•135 Cooling Tower Blowdown, S E of Bldg 374	Tritium Chromium Phosphate	A B C	SW043	SED010	None	None
•137 Cooling Tower Blowdown, Bldg 774	Chromium	B	SW102	SED120	None	None
•138 Cooling Tower Blowdown, Bldg. 779	Alpha Chromium Phosphate	A B C	SW085	None	None	None
•139 1(N) Hydroxide Tank Area (Bldg. 774)	Sodium Hydroxide	B	SW086	SED120	SW084	SED124
•139 1(S) Hydroxide Tank Area (Bldg. 771)	Potassium Hydroxide	B	SW102	SED120	None	None
•139 2 Hydrofluoric Acid Tank Area (Bldg. 714)	Hydrofluoric Acid	C	SW102	SED120	None	None

1) Refer to Figure 1-9 for location of Drainage Basins

2) Source Hazardous Release Report, January, 1992 (DOE, 1992)
3) Contaminant Types
A - Radionuclides B - Trace Metals C - Inorganics D - Volatile Organics
4) Surface-water and sediment monitoring sites which are located nearest downstream from the IHSS

TABLE 1.8 - Continued

Description of IHSS Contaminants and Affected Surface-Water Drainage Basins[1]

Drainage Basin/IHSS		Released Contaminants[2]	Type[3]	Monitoring Site[4]			
				Downstream		Upstream	
				Surface	Sediment	Surface	Sediment
•144	Sewer Line Breaks, Bldg 730, Tanks 776 A-D	Rad. Process WW Alpha High-Level Rad Sludge	A	SW102	SED120	None	None
•150 1	Radioactive Site, N of Bldg 771	Plutonium Americium Nitric Acid	A	SW084 SW124	SED124	None	None
•150 2	Radioactive Site, W. of Bldg 771	Plutonium	A	SW018	SED010	None	None
•150 3	Radioactive Site, Between Bldgs 771 and 774	Plutonium Process WW (Low-Level Rad)	A	SW084	SED120	None	None
•150 6	Radioactive Site, S. of Bldg 779	Unknown Rads	A	SW085		None	None
•150 7	Radioactive Site, S of Bldg 776	Plutonium	A	SW018	SED010	None	None
•150 8	Radioactive Site, N E. of Bldg. 779	Unknown Rads	A	SW085	SED009	None	None

1) Refer to Figure 1-9 for location of Drainage Basins

2) Source Hazardous Release Report, January, 1992 (DOE, 1992)
3) Contaminant Types.
A - Radionuclides B - Trace Metals C - Inorganics D - Volatile Organics
4) Surface-water and sediment monitoring sites which are located nearest downstream from the IHSS

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TABLE 1.8 - Continued

Description of IHSS Contaminants and Affected Surface-Water Drainage Basins[1]

Drainage Basin/IHSS		Released Contaminants[2]	Type[3]	Monitoring Site[4]			
				Downstream		Upstream	
				Surface	Sediment	Surface	Sediment
•151	Fuel Oil Leak, N of Bldg 374	No 2 Diesel Fuel	D	SW043	SED010	None	None
•163 1	Radioactive Site, 700 Area Site #3, Wash Area N E of Bldgs. 774	Low-Level Rads Inorganic Compounds Organic Compounds	A C D	SW120* SW119* * no data	SED120 available	None	None
•163 2	Radioactive Site, 700 Area Site #3, Buried Slab N of Bldgs 771 and 774	Americium	A	SW124	SED124	None	None
•172	Central Avenue Waste Spill	Plutonium Uranium Berylium Acetone Perchloroethane Trichloroethane	A D	SW018	SED010	None	None
•188	Acid Leak (SE of Bldg. 374)	Hydrochloric Acid Nitric Acid	C	SW018	SED010	None	None

1) Refer to Figure 1-9 for location of Drainage Basins

2) Source Hazardous Release Report, January, 1992 (DOE, 1992)
3) Contaminant Types
A - Radionuclides B - Trace Metals C - Inorganics D - Volatile Organics
4) Surface-water and sediment monitoring sites which are located nearest downstream from the IHSS

TABLE 1.8 - Continued

Description of IHSS Contaminants and Affected Surface-Water Drainage Basins[1]

Drainage Basin/IHSS	Released Contaminants[2]	Type[3]	Monitoring Site[4]			
			Downstream		Upstream	
			Surface	Sediment	Surface	Sediment
II SOUTH WALNUT CREEK						
•118 2 Solvent Spill S End of Bldg 776	Carbon Tetrachloride Benzene Dichloromethane 1,1,1-Trichloroethane Methylethylketone Petrolium Distillates	D	SW122	SED011	None	None
•123 1 Valve Vault 7, S W. of Bldg 707	Process WW	A	SW122	SED011	None	None
•150 4 Radioactive Site, E. of Bldg 750	Decon Water Plutonium (suspected)	A	SW122	SED011	None	None
•150 7 Radioactive Site, S of Bldg 776	Plutonium	A	SW122	SED011	None	None

1) Refer to Figure 1-9 for location of Drainage Basins

2) Source Hazardous Release Report, January, 1992 (DOE, 1992)
3) Contaminant Types
A - Radionuclides B - Trace Metals C - Inorganics D - Volatile Organics
4) Surface-water and sediment monitoring sites which are located nearest downstream from the IHSS

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TABLE 1.8 - Continued

Description of IHSS Contaminants and Affected Surface-Water Drainage Basins[1]

Drainage Basin/IHSS		Released Contaminants[2]	Type[3]	Monitoring Site[4]			
				Downstream		Upstream	
				Surface	Sediment	Surface	Sediment
•172	Central Avenue Waste Spill	Perclene Plutonium Uranium Solvent Oil Carbon Tetrachloride	A D	SW059	SED011	None	None
•173	Radioactive Site, 900 Area (Storage Vaults near Bldg 991)	Plutonium Uranium Berylium Acetone Perchloroethane Trichloroethane	A D	SW056	SED011	SW122	None
•184	Radioactive Site, Bldg 992 Steam Cleaning Area	Decon. Water (unknown)	A	SW060	SED011	SW056	None

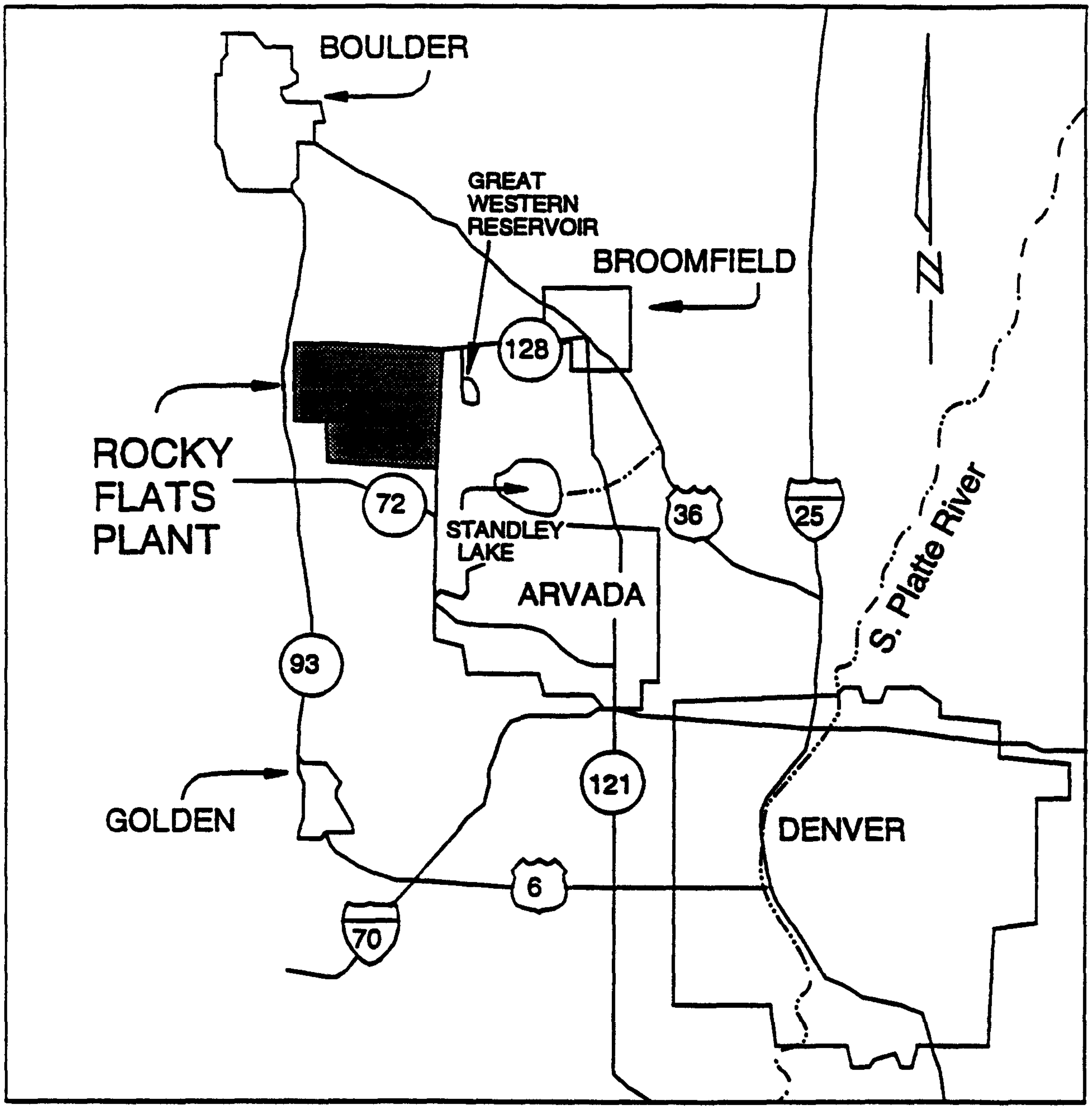
1) Refer to Figure 1-9 for location of Drainage Basins

2) Source Hazardous Release Report, January, 1992 (DOE, 1992)
3) Contaminant Types
A - Radionuclides B - Trace Metals C - Inorganics D - Volatile Organics
4) Surface-water and sediment monitoring sites which are located nearest downstream from the IHSS

TABLE 1-9

Hydraulic Conductivities For Geologic Materials At RFP

Hydrostratigraphic Unit	*Hydraulic Conductivity, k, cm/sec*	
Recent and colluvial sediments	Untested	
Valley Fill Alluvium	1.8×10^{-2}	(Doty, 1992b)
Valley Fill Alluvium	3×10^{-3} - 5×10^{-6}	(EG&G, 1991k)
Rocky Flats Alluvium of HSU 1	1×10^{-2} - 7×10^{-5}	
Arapahoe sandstone of HSU 1 (weathered, unconfined)	4×10^{-5} - 2×10^{-8}	
Arapahoe sandstone of HSU 1 (unweathered, confined)	2×10^{-6} - 4×10^{-8}	
Arapahoe claystone (flanking HSU 1 sandstones)	1×10^{-7} - 1×10^{-8}	(EG&G, 1991k)



Approved By [signature] Date 10/28/92

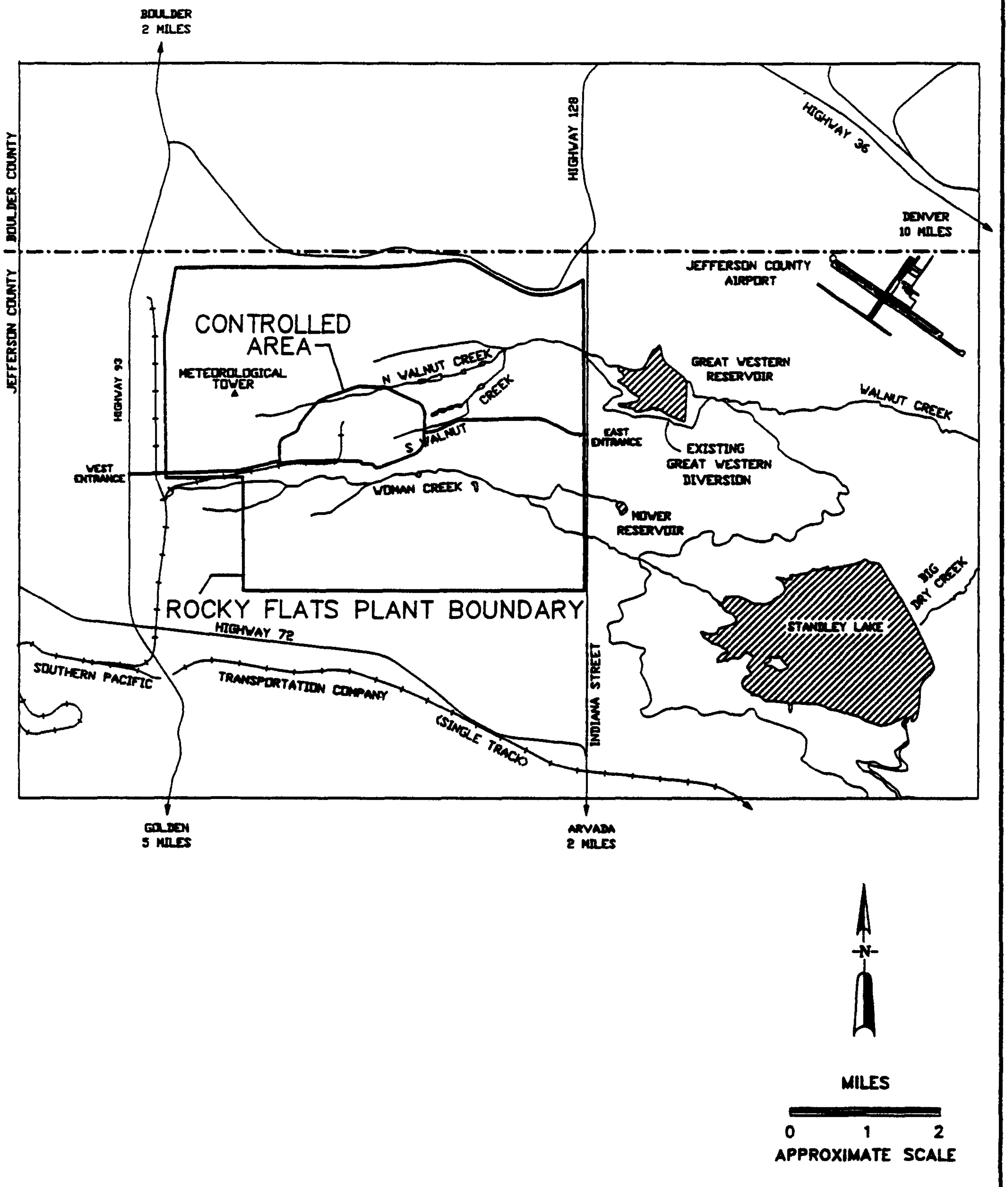
FIGURE 1-1
SITE LOCATION MAP - ROCKY FLATS PLANT

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

51/82

File Name OU81-2 DWG



Approved By Tom A. Peochis Date 11/20/92

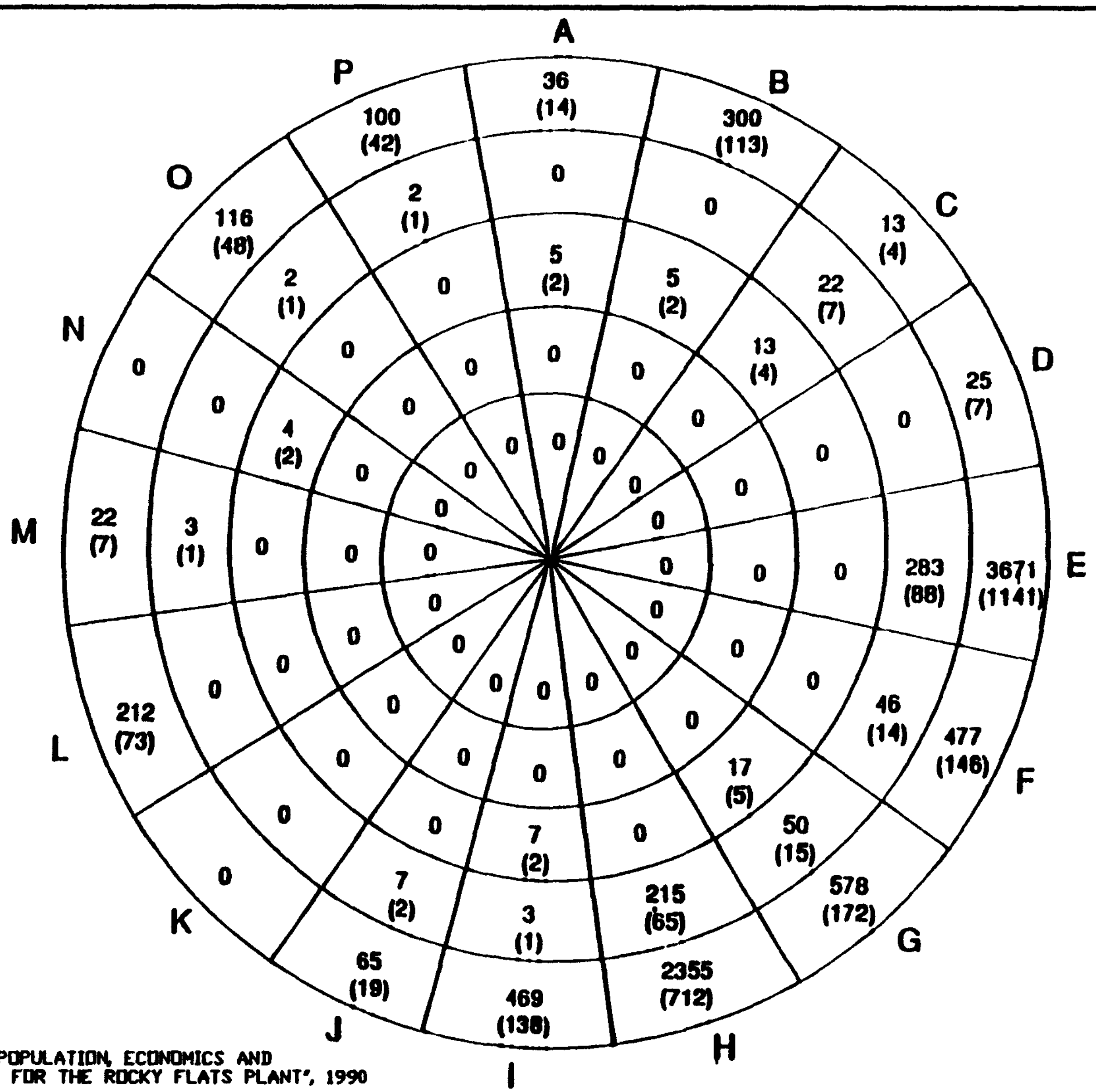
FIGURE 1-2
ROCKY FLATS PLANT

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

53/82

Approved By Tom A Parchu Date 10/28/92



Miles	Sector Name
0-1	Sector 1
1-2	Sector 2
2-3	Sector 3
3 4	Sector 4
4-5	Sector 5

KEY

INHABITANTS 578

HOUSEHOLDS (172)

N

NOT TO SCALE

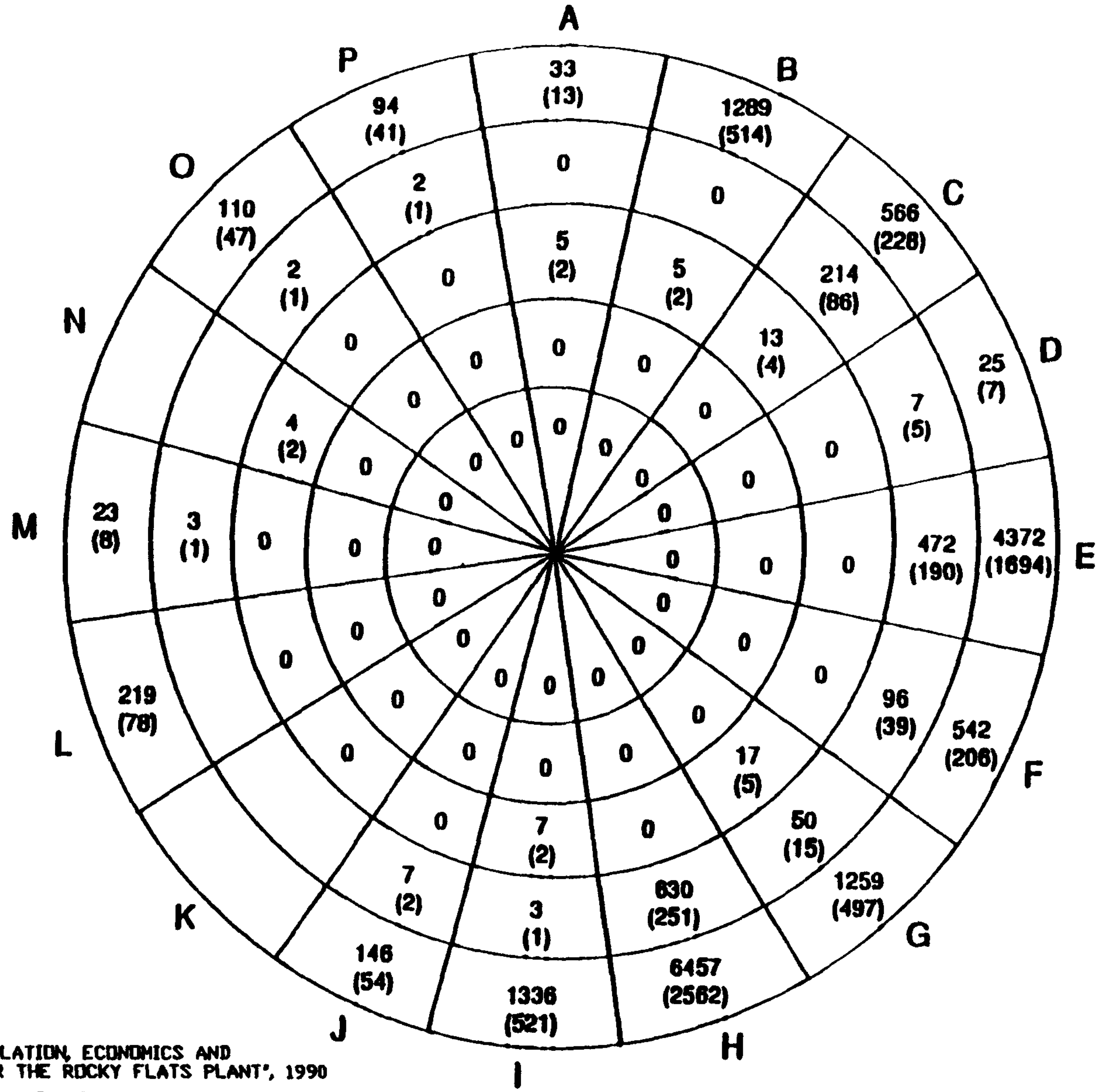
SOURCE: DOE, '1991a POPULATION, ECONOMICS AND LAND USE DATA BASE FOR THE ROCKY FLATS PLANT', 1990

FIGURE 1-4
1989 POPULATION DISTRIBUTION, WITHIN 5 MILES OF THE ROCKY FLATS PLANT SITE

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

Approved By Tim A Paschis Date 10/28/92



Miles	Sector Name
0-1	Sector 1
1-2	Sector 2
2 3	Sector 3
3 4	Sector 4
4-5	Sector 5

KEY

INHABITANTS 578

HOUSEHOLDS (172)

-N-

NOT TO SCALE

SOURCE: DOE, "1991a POPULATION, ECONOMICS AND LAND USE DATA BASE FOR THE ROCKY FLATS PLANT", 1990

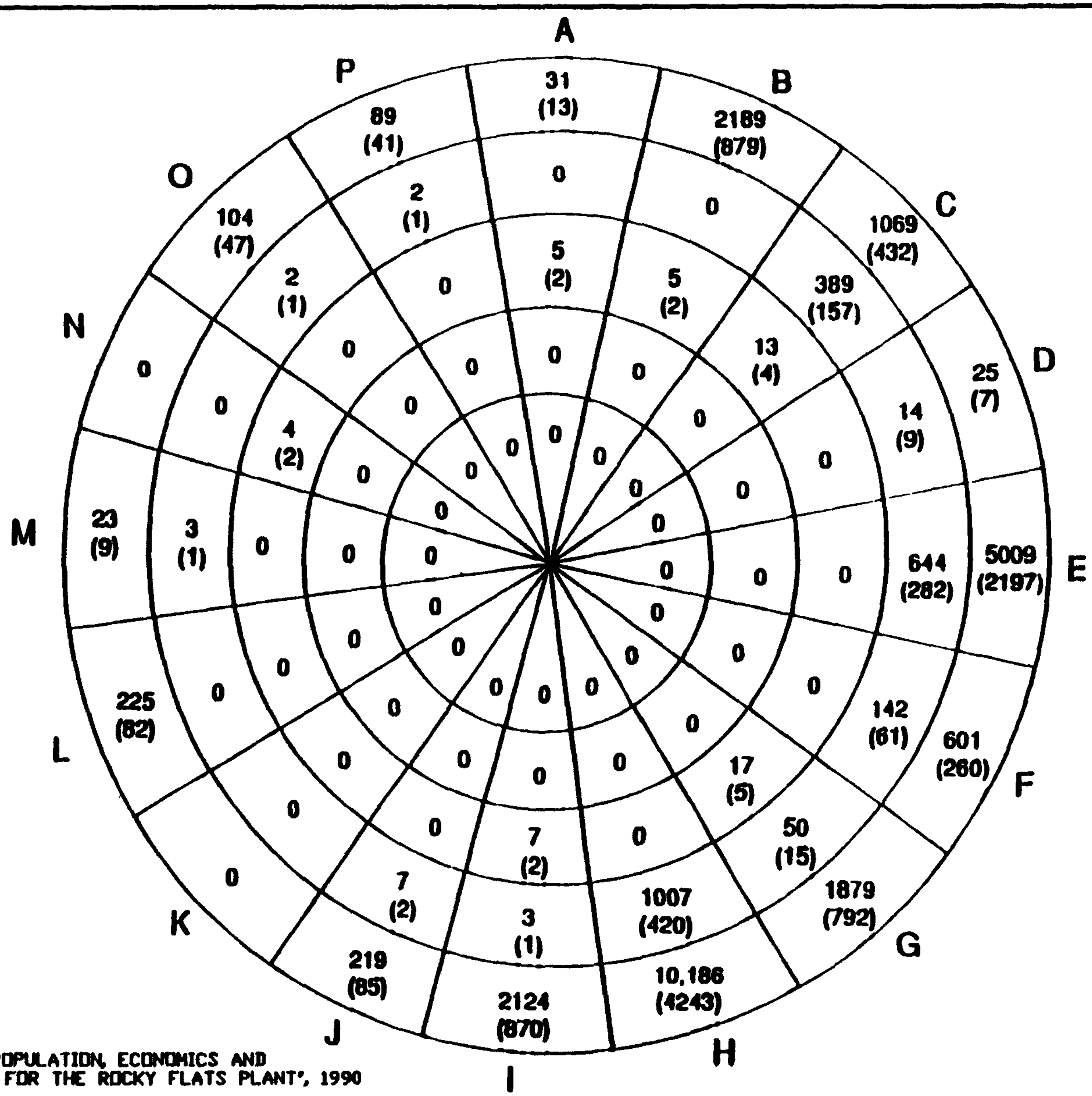
FIGURE 1-5
EXPECTED POPULATION AND DENSITY DISTRIBUTION AROUND THE ROCKY FLATS PLANT IN THE YEAR 2000

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

54/82

Approved By Jim A Paschis Date 10/28/92



Miles	Sector Name
0-1	Sector 1
1 2	Sector 2
2-3	Sector 3
3-4	Sector 4
4-5	Sector 5

KEY

INHABITANTS 578

HOUSEHOLDS (172)

NOT TO SCALE

SOURCE: DOE, '1991a POPULATION, ECONOMICS AND LAND USE DATA BASE FOR THE ROCKY FLATS PLANT', 1990

FIGURE 1-6
EXPECTED POPULATION AND DENSITY DISTRIBUTION AROUND THE ROCKY FLATS PLANT IN THE YEAR 2010

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

55/82

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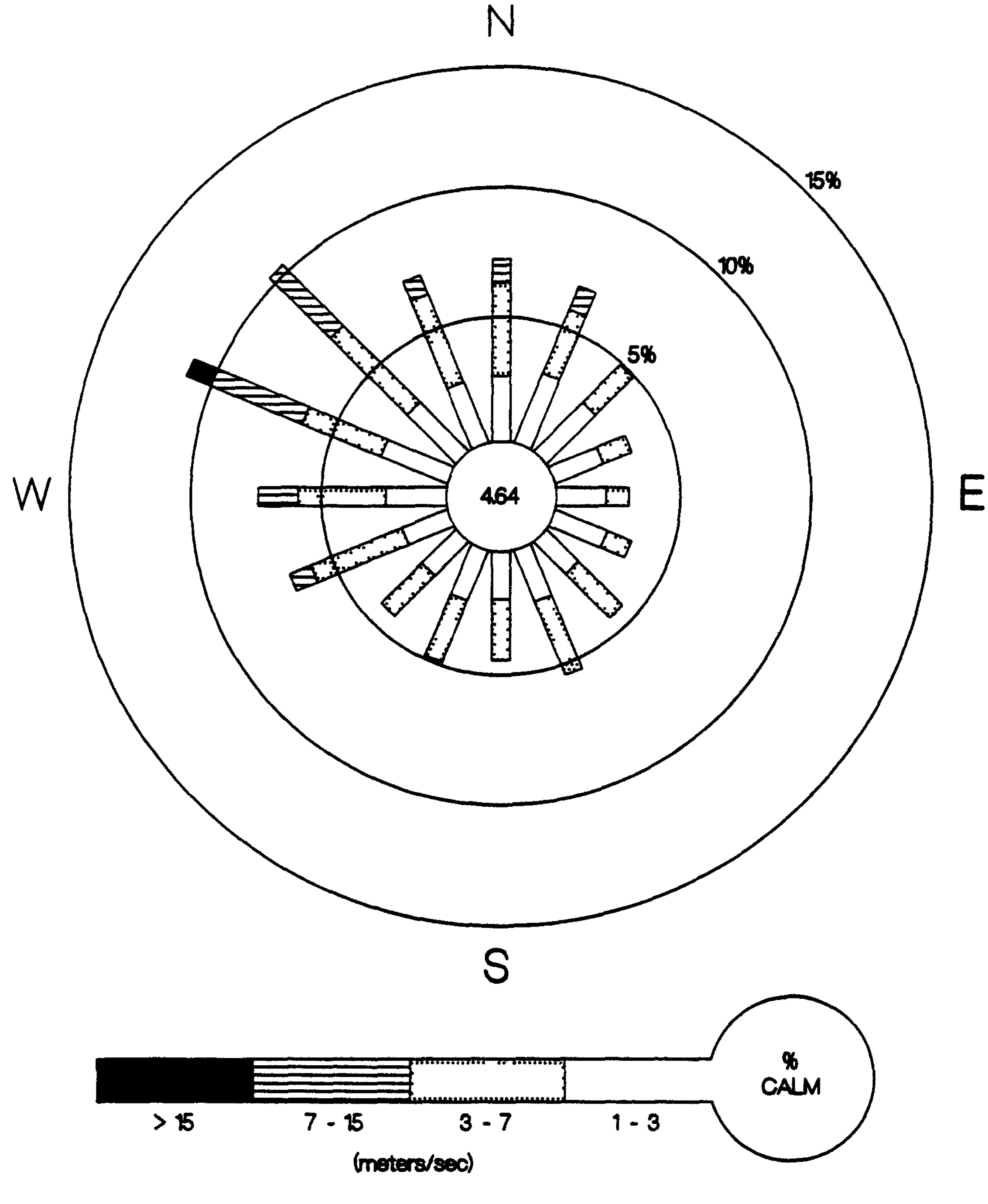
File Name OU81-7 DWG



Approved By [signature] Date 10/28/92

FIGURE 1-7
WIND ROSE FOR THE
ROCKY FLATS PLANT, 1990

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

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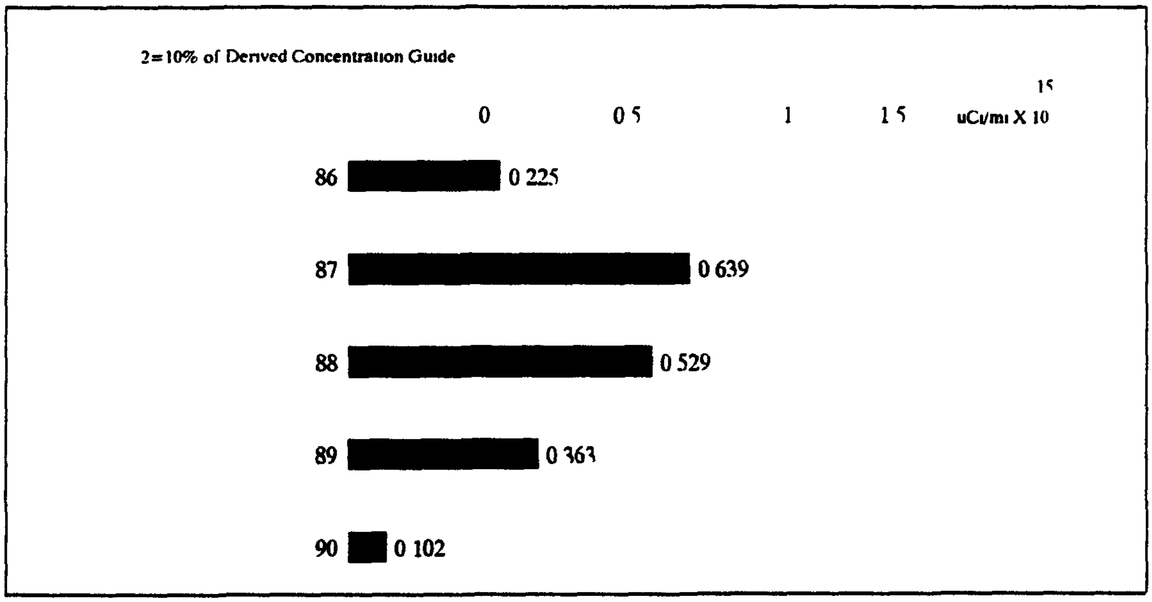

Figure 1-10 Plutonium 239,-240 Onsite Concentrations, 1986-1990

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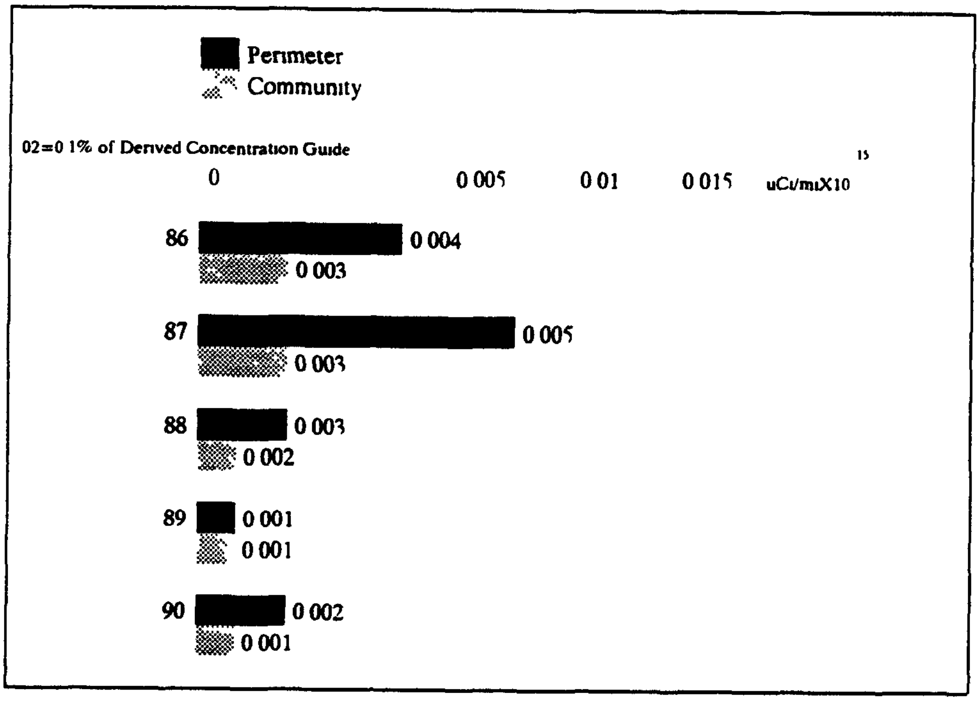

Figure 1-11 Plutonium 239,-240 Perimeter and Community Concentrations, 1986-1990

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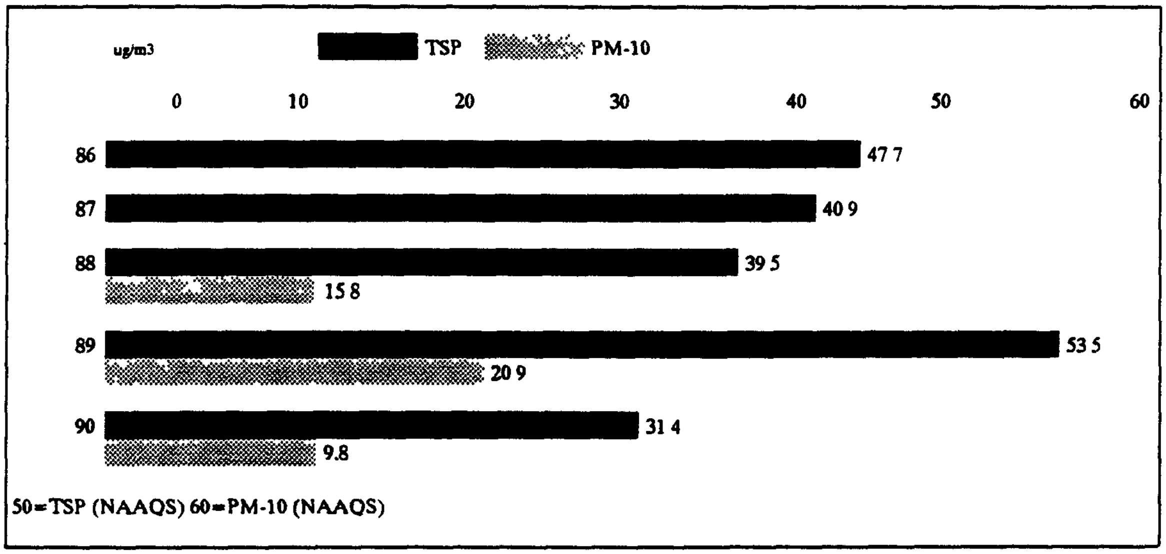

Figure 1-12 TSP Results, 1986-1990, and PM-10 Results, 1988-1990

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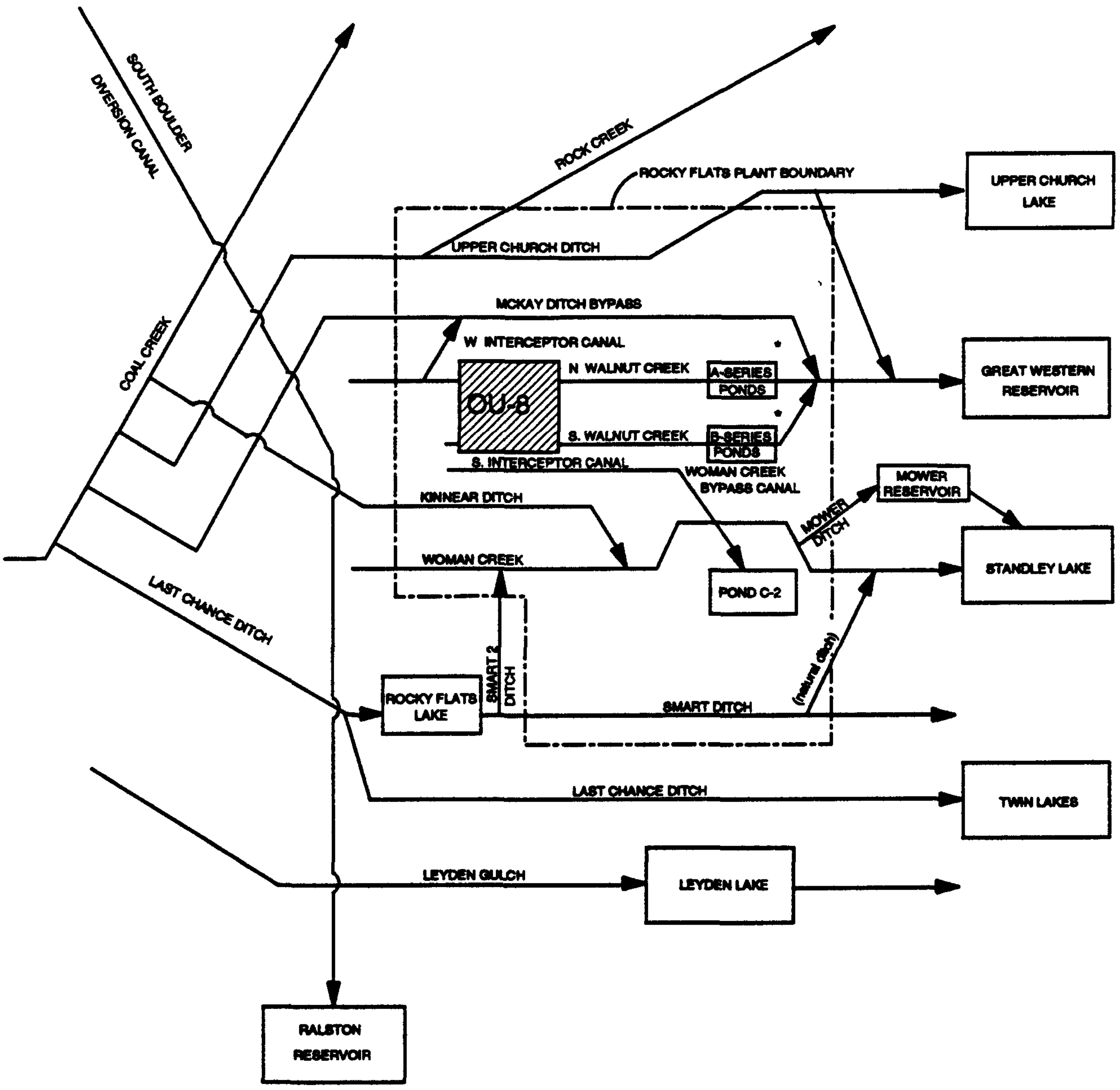


* See Figure 1-16 for details

Adapted from HURR (1976)

SCHEMATIC DIAGRAM OF SURFACE-WATER SYSTEM

OU-8 WORK PLAN

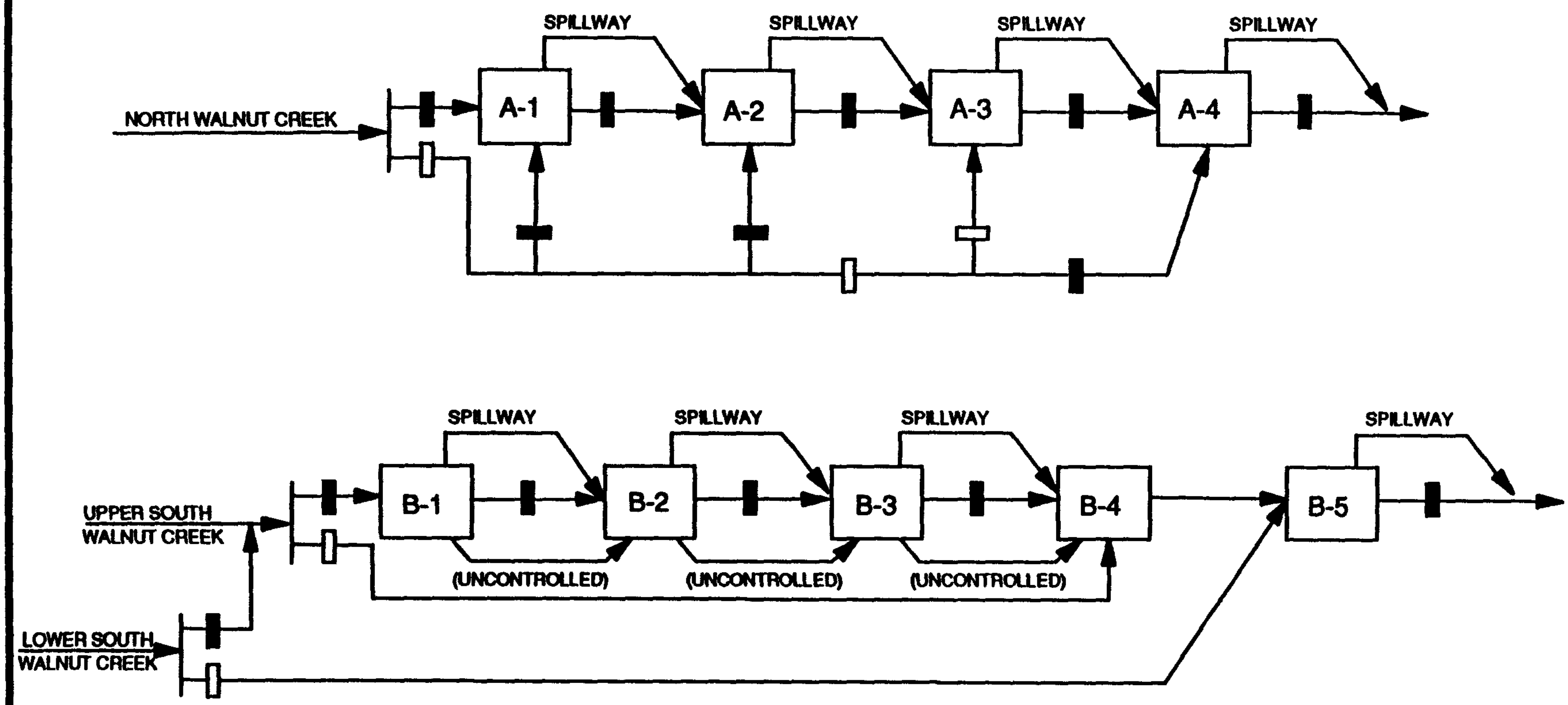
ADVANCED SCIENCES, INC.

PROJECT 208 14 FIGURE 1-14

F101-14.DRW

Approved By [signature] Date 11/20/92

Approved By Tyler D Smart Date 11/20/92



NORMALLY CLOSED VALVE

NORMALLY OPEN VALVE

NOTE Spillways are provided for major flows in excess of the pond storage capacity

SCHEMATIC DIAGRAM OF SURFACE-WATER DRAINAGE AT A & B RESERVOIRS

OU-8 WORK PLAN

ADVANCED SCIENCES, INC.

PROJECT 208 14 FIGURE 1-16

FIG01 16.DRW

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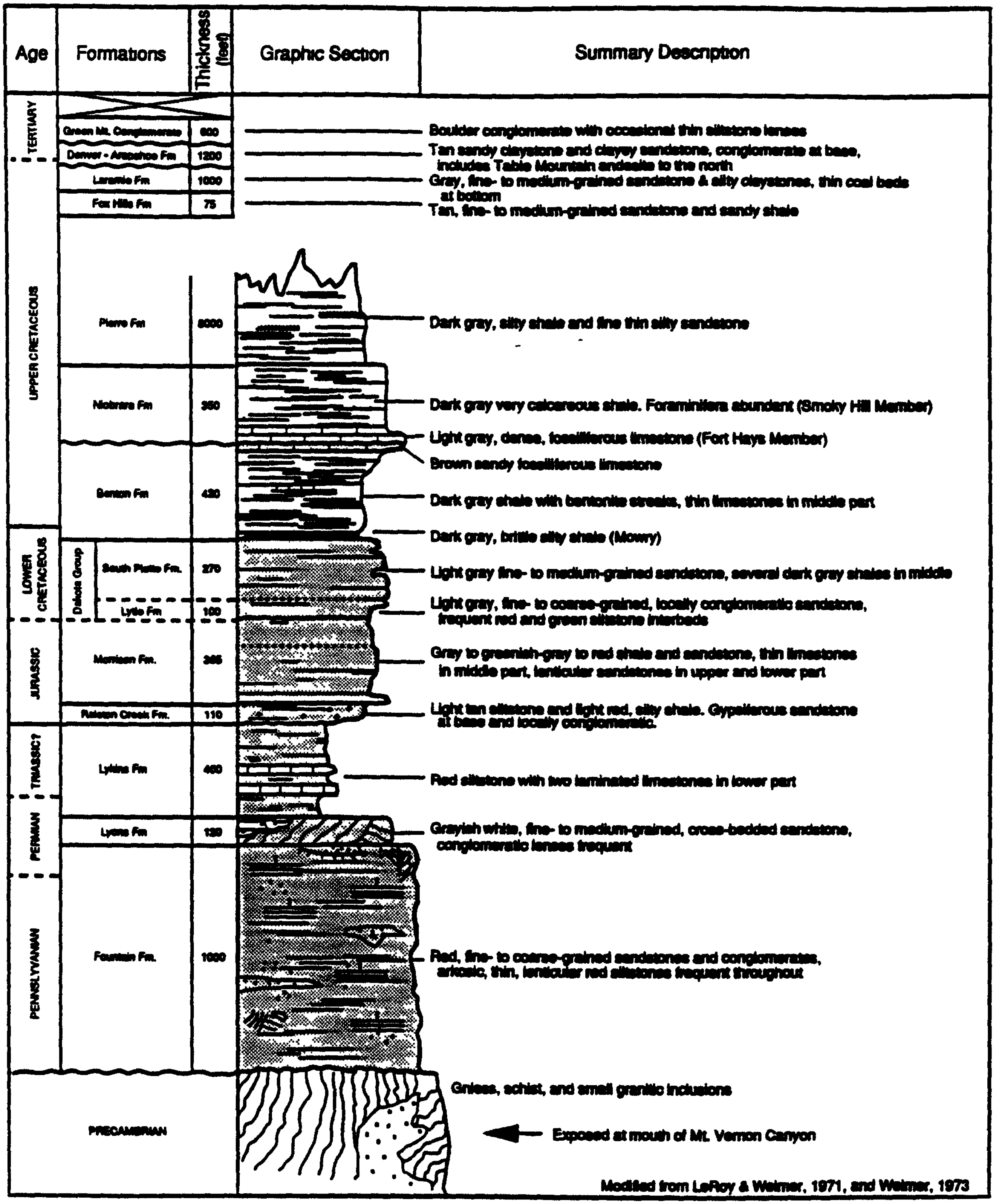

Approved By Tom Q Paschis Date 10/28/92

FIGURE 1-22
GENERALIZED STRATIGRAPHIC SECTION, GOLDEN - MORRISON AREA

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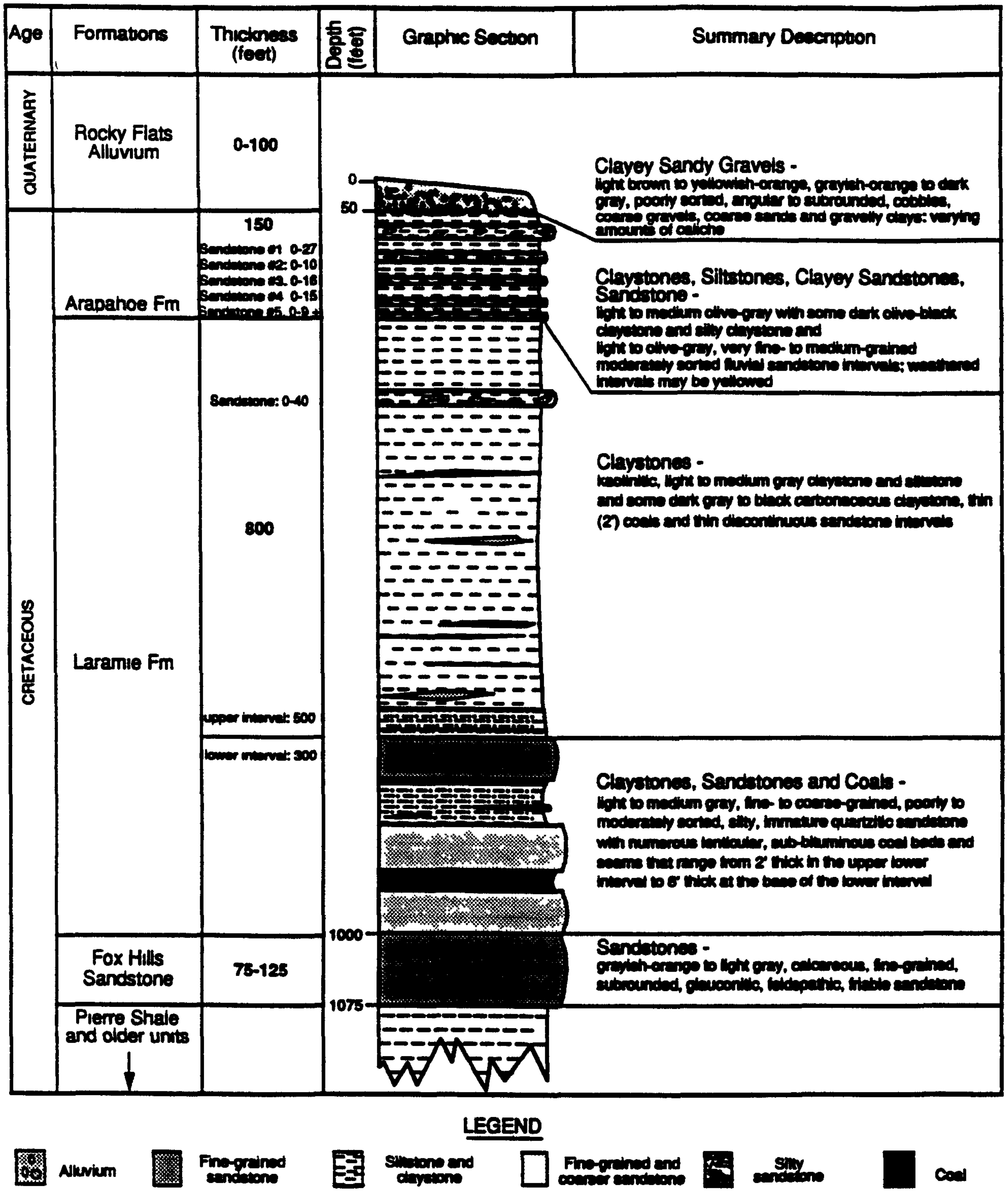


Approved By Tim A Paschis Date 10/28/92

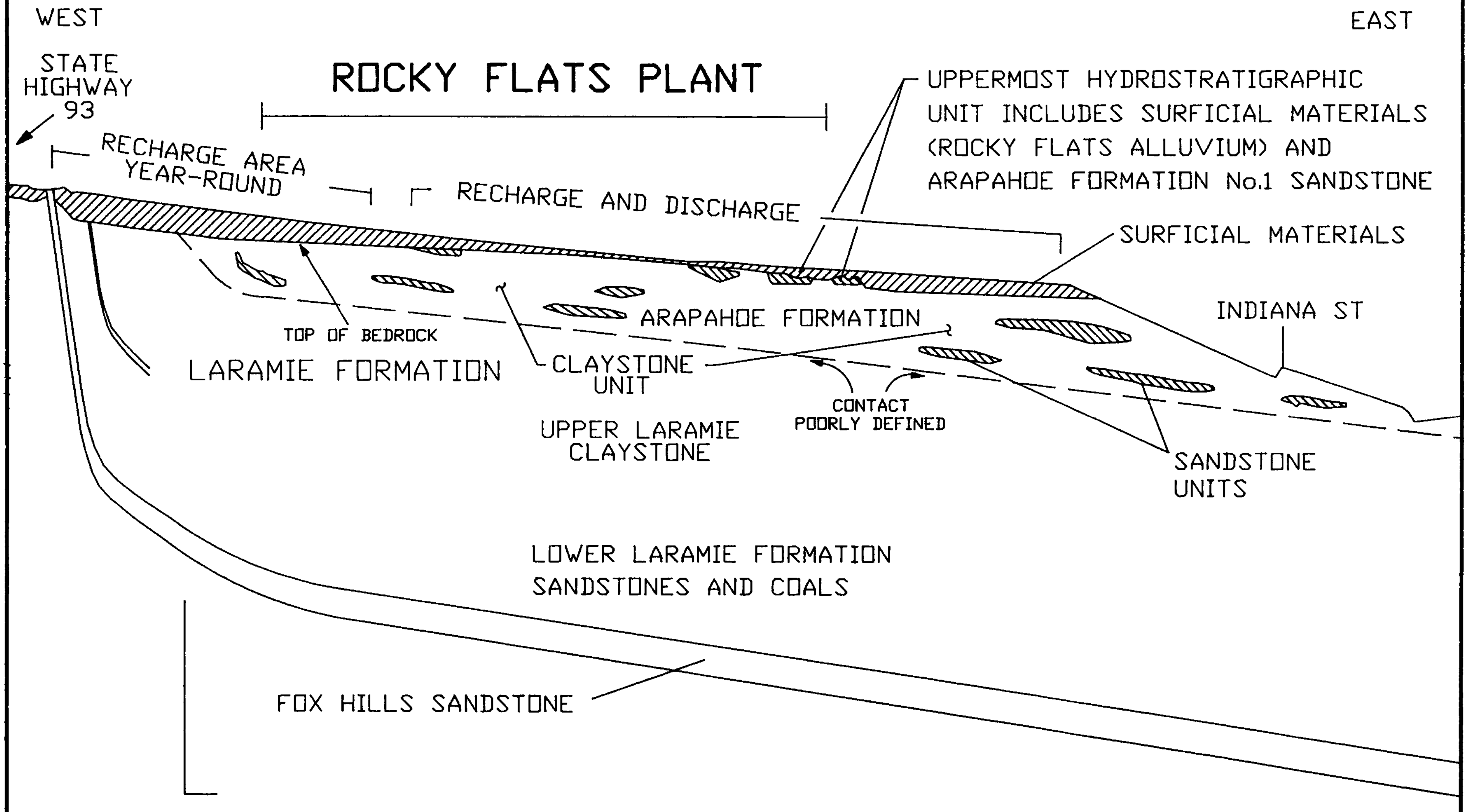
FIGURE 1-23
GENERALIZED STRATIGRAPHIC SECTION, ROCKY FLATS PLANT

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

Approved By James D [signature] Date 11 /23/92

File Name 0U81-31 DWG



VERTICAL EXAGGERATION 6:1

Based upon EG&G 1991k, Fig 3 4 1
Rocky Flats Plant Site Environmental Report 1990

FIGURE 1-31
SCHEMATIC WEST TO EAST STRUCTURAL CROSS SECTION

OPERABLE UNIT NO 8
PHASE I RFI/RI WORK PLAN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

80/82

(Drawing RF-FS-21951, March 9, 1956), a tunnel connects Buildings 883 and 881, and a drain line on the west side of this tunnel connects to the foundation drain system for Building 881. The north end of the drain line was connected to a sump at the southwest corner of Building 883 until 1984 when the sump was moved and the discharge from it was rerouted (Section 3.20) The Foundation Drain Plan (Drawing 25581-2, rev. December 9, 1975) does not show the drain along the tunnel.

According to the Plot Plan (Drawing 1-11609-81, rev. May 23, 1963), the foundation drain outfalls at a concrete headwall on the hillside south of the plant site This outfall, FD-881-1, was historically sampled under the routing sampling program until 1991 The water is currently sampled approximately monthly as part of OU1 sampling The outfall is not sampled under the current program because the discharge is collected in a sump located at the outfall on the hillside and the water is routed to the OU1 treatment system (Collection Gallery and Pipeline Plan, Drawing 38548-128, January 19, 1991, Cirillo 1993, Burmeister 1993)

Based on the Storm and Sanitary Drain drawing (Drawing RF-81-100, rev. July 23, 1953), the underbuilding storm drain system is composed of 8-, 10-, 12-, and 15-inch cast iron pipes Several 6-inch downspouts from building roof drains tie in to the storm drains. The water discharges through a 15-inch vitrified clay pipe storm drain near the southeast corner of the building and flows to a previously unnamed outfall on the hillside south of the plant The outfall supports a localized wetland area with numerous cattails and has never been sampled To maintain the wetland, the discharge from this system is not collected. However, some of the discharge flows down the hillside and is collected in the french drain system which is treated by the OU1 treatment facility (Burmeister 1993) The water source from this system is rainwater collected on the roof of Building 881, unless the cast iron pipes have deteriorated since they were installed in 1953. If the pipes have deteriorated, groundwater may be infiltrating into the system and discharging at the outfall

The basement of Building 881 has an extensive utility tunnel network (Drawing RF-81-100, rev. July 23, 1953) and a system of 4-inch cast iron pipes beneath the tunnel floors. The tunnels contain numerous floor drains that are connected to the system. The cast iron pipes discharge to a sump (BS-881-2) in the boiler room near the south end of the building

Two sumps in Building 881 have historically been included in the sampling program. BS-881-2, located in an elevator shaft by the boiler room, was deleted from the sampling program because "the sample consists mostly of oil from the elevator and this water is pumped to sanitary waste" (Hoffman 1983). A 4-inch sump pump discharge pipe connects the utility tunnel pipe system to a 6-inch sanitary sewer pipe, according to the Storm and Sanitary Drains drawing (Drawing RF-81-100, rev July 23, 1953). Unless the pipes have deteriorated to allow groundwater infiltration, building sump BS-881-2 collects only water from the utility tunnel floor drains

Werkema (1977) first identified BS-881-3 as the sump under the stairway in the northeast corner of the first floor. BS-881-3 was sampled until 1990 when it was deleted from the sampling program because of access problems (Barros 1992)

3.18 BUILDING 883 - ROLLING AND FORMING FACILITY

The Foundation Plan for Building 883 (Drawing 1-5373-83, rev. January 20, 1965) shows a 6-inch perforated foundation drain exists, as shown in Figure 17. A segment of drain pipe beneath the southeast corner of the building is shown on the Foundation Plan but is omitted on the Foundation Drain Plan for Building 883 (Drawing 25581-9, rev. December 9, 1975)

The foundation drain system discharges to a sump at the southwest corner of the building. The sump was connected to the Building 881 foundation drain system, according to the Foundation Drain Lines Plan for the original building (Drawing RF-FS-21951, March 9, 1956) The sump, FD-883-1 (BS-883-1 prior to 1992), was relocated when an addition was constructed on the southwest corner of Building 883 in 1984 (Drawing 28483-022, rev February 6, 1986). The new sump, in the southwest corner of the addition, is connected to a storm drain by a 4-inch PVC discharge pipe (Drawing 28483-022, rev February 6, 1986) The storm drain discharges to the ground surface west of Building T883D (Drawing 15501-043-M, rev July 20, 1990), but the outfall was not found during site reconnaissance.

3.19 BUILDING 886 - NUCLEAR SAFETY FACILITY

Building 886 has two foundation drain segments and collection points. On the west side of the building, a 6-inch corrugated metal pipe slopes south to a collection manhole, FD-886-2, near the southwest corner of Building 886 (Drawings 15501-043-M and 15501-044-M, rev. July 20, 1990) The tunnel between Buildings 886 and 875 is also flanked by 6-inch corrugated metal pipe foundation drain (Drawing 25925-1, rev August 30, 1977), as shown in Figure 15 The drain trenches were backfilled with 2 feet of class 2 structural backfill. The tunnel drains discharge to a sump (FD-886-1) east of Building 875 Water from the manhole (FD-886-2) also flows to this sump (Drawing 15501-043-M, rev July 20, 1990) The sump historically discharged through a 1 25-inch pipe (Drawing 17242, September 27, 1965) to the ditch south and east of the sump (Drawing 23482-302, rev March 1975, Drawing 17242, September 27, 1965) However, discharge from the sump to the ditch was not observed during any site reconnaissance.

Both the sump and manhole were sampled regularly until 1993. Because of uranium counts, the water is now pumped from the manhole and sump by a vacuum truck and transported to Building 374 for treatment (Appendix F) The sump and manhole have been pumped one to two times each week since approximately May 1993, according to Mr. Steve Barros (Appendix F)

3.20 BUILDING 887 - BUILDING 881 SUPPORT

Building 887, south of Building 881, was constructed in 1952 with a foundation drain system of 6-inch perforated corrugated metal pipe (Drawing RF-81-F9-E, rev July 1978). This system is connected to the Building 881 system, as shown in Figure 16 The foundation drains slope toward the middle of the east wall from the northwest corner. From this point, the foundation drain water from Building 887 joins those from Building 881 and discharges at station FD-881-1 (Section 3 19).

3.21 BUILDING 910 - OU4 EVAPORATION TREATMENT FACILITY

Yashan and Barros (1992) referred to a foundation drain for Building 910 However, the drain is not identified on engineering drawings or site utility drawings (Appendix A) Foundation drain waters reportedly collect at a sump, FD-910, at the northwest corner of Building 910 and discharge at ground surface northeast of the building (Appendix F) This sump is shown in Figure 18

3.22 BUILDINGS 991 AND 998 - PRODUCT WAREHOUSE

According to the Plot Plan (Drawing 15708-1, rev. February 24, 1967), Building 998, an underground storage vault (Drawing 25581-11, rev. December 9, 1975), and Building 991 are connected by a tunnel and have foundation drain systems. The foundation and storm drains are presented in Figure 19 The foundation drain for Building 998 originates at the northeast corner of the structure, slopes west, south, and east around the perimeter of the structure, then slopes south along the west wall of the tunnel and connects to the Building 991 foundation drain system (Plot Plan Drawing 15708-1, rev. February 24, 1967)

The Building 991 foundation drain consists of a 6-inch, asphalt coated, perforated drain pipe that originates at the northwest corner of the building and slopes east along the north wall of the building The western section slopes south, then west, and connects to a storm drain which discharges to a ditch on the western side of Building 991. Recent efforts to locate this pipe have been unsuccessful

An 8-inch storm drain in the floor of the utility tunnel near the north part of the building is also connected to the northern foundation drain (Drawing 1-3354-91, rev August 29, 1952, Drawing 1-7084-91A, rev July 10, 1959) A 6-inch downspout connects to the drain at the west end of the tunnel, possibly from a roof drain In 1959, an addition was constructed on the northeast corner of Building 991 A 6-inch, perforated, corrugated steel foundation drain pipe was installed around the exterior of the addition with a backfill of coarse gravel. This drain was connected to the old foundation drain system at the southeast corner of the addition. The foundation drains outfall at an open ditch approximately 170 feet east of Building 991 (Drawing 1-7084-91A, rev. July 10, 1959). A number of site reconnaissance have observed that this outfall is a wetlands area just inside the security fence It was sampled as station FD-991-1 until 1992 when the station was removed from the program The pipe outfall was not located during site reconnaissance, perhaps because visibility and access were obstructed by cattails and standing water. Hoffman (1983) stated that the sampling location was a manhole inside the security fence although, in 1981, Hoffman described the location as a gully outside the security fence (Hoffman 1981). According to Ms. Sharon Wilson, Building 991 manager (Wilson 1993), the outfall has been routed to the 8-inch sanitary sewer pipe east of the northeast corner of Building 991.

Building sump BS-991-2, located in the southeast corner of Building 991, was added to the sampling program in 1992. Building 991 personnel report that the foundation drain was rerouted to this sump (Yashan and Barros 1992) although this has not been verified by the building drawings (Appendix A) or building manager (Wilson 1993) Most of the underground structure for Building 991 is at an elevation of 5 to 10 feet below the elevation of the foundation drain Yashan and Barros (1992) state that the sump discharges to the sanitary sewer

3.23 BUILDING 995 - SANITARY TREATMENT PLANT

The Piping Plan (Drawing 20722-61, rev September 2, 1970) shows a 6-inch vitrified clay pipe around one digester and aerator clarifier and beneath the sludge beds in Building 995 The original building construction drawings could not be found, but drawings for additions to the facility are available (Appendix A). Huffman (1993) stated that leachate collected from under the sludge beds is piped to the intake and treated with the rest of the wastewater This may be true of water collected from around the digester and aerator clarifier, but the existing drawings are unclear The layout of foundation drains and suspected outfalls for Building 995 is given in Figure 20

According to the Site Utility Plans (Drawing 15501-024-M, rev. June 14, 1990), three foundation drains outfall on the hillside south of the wastewater treatment facility Mr Frank Huffman, Building 995 Shift Supervisor, is not aware of the outfalls (Huffman 1993), and the outfalls could not be located during the November 1993 site reconnaissance (Appendix F). It is possible that the outfalls shown on the utility drawing were constructed for the original facility and have since been removed None of the Building 995 foundation drains has been sampled

3.24 BUILDINGS 996, 997 AND 999 VAULTS AND TUNNELS - STORAGE

Buildings 996, 997, and 999 are underground storage vaults located north and west of Building 991, they are connected to Building 991 by a tunnel. The three buildings were constructed with foundation drains of 6-inch, asphalt-coated, perforated pipe (Drawing 13812-3, rev March 11, 1968 and Drawing RF-99-17701, rev. June 6, 1956) with gravel backfill. The layout and slope of the drain system for the three structures and tunnel is shown in Figure 18.

Buildings 996 and 997 were constructed in 1952 Building 999 was constructed in 1956 and the foundation drains were connected to the existing drain system (Drawing RF-99-17701, rev June 6, 1956) However, the Foundation Drain Plan for Buildings 996, 997, and 999 (Drawing 25581-12, rev. December 9, 1975) does not show a drain around Building 999, based on Drawing RF-99-17701 (rev June 6, 1956)

The Concrete-Plans and Section drawing for Building 999 (Drawing RF-99-17701, rev June 6, 1956) indicates that the drain is approximately 2 feet below the finished floor elevation Assuming that all drains are approximately 2 feet below the finished floor elevation, the drain elevations can be estimated The finished grade elevation varies above the structures and tunnel The finished grade elevation above Building 999 is approximately 24 feet above the elevation of the drains for that structure

The foundation drains slope southward along the west side of the tunnel (Drawing 25581-12, rev December 9, 1975) The Tunnel Plan for Buildings 996 and 997 (Drawing 13812-3, rev

March 11, 1968) indicates that the drain pipe is located approximately 62 feet west of the northwest corner of Building 991. The outfall location for the system is not shown on the drawings and has not been located by SWD personnel. The outfall is believed to correspond to the perforated drain pipe on the west side of Building 991, which was noted on the area plot plan drawing for Building 991 and 998 (Drawing Number 15708-1, rev February 24, 1967). This pipe may connect to the storm sewer south of Building 991. This connection might be confirmed with the 24-hour CCTV video footage of the storm sewer system It is not known if the drain pipe still exists. Construction in the area where the drain pipe is shown, including additions on to the west side of Building 991 and the construction of Building 985, may have resulted in the pipe being rerouted, blocked, or removed completely

Approved By·

_____________________ __/__/__
Director (Date)

_____________________ __/__/__
Project Manager (Date)

_____________________ __/__/__
Quality Assurance Program Manager (Date)

4.0 WATER QUALITY RESULTS

This section begins with a summary of historical sampling frequency, analytes, and available foundation drain and building sump data. The analytical results from historical and recent sampling are summarized. Trends in analyte concentrations at individual sampling locations are also evaluated. Recommendations are presented for changes to the existing sampling program and for one-time sampling as part of the OU8 RFI/RI.

4.1 SAMPLING FREQUENCY

Analytical results from foundation drain and building sump monitoring are available from 1977 to the present. No data from sampling events prior to August 1977 have been identified. Dow Chemical Company reportedly may have sampled foundation drains before 1977, but supporting documentation and data could not be located. Table 3 summarizes the frequency of foundation drain and building sump sampling, according to available information. Records indicate that the foundation drains and building sumps were sampled once in 1977, twice in 1978, three times in 1979 and in 1980, and twice in 1981. The results were not subject to regulatory standards, but were compared to internally established levels (referred to as administrative control guides) set for gross alpha, gross beta, conductivity, nitrate as NO_3, pH, total dissolved solids, and tritium.

Table 3 – Foundation Drain and Building Sump Sampling Frequency 1977–1993

1977		1978		1979		1980		1981		1988		1989	
Station	Date	Station	Date	Station	Date	Station	Date	Station	Date	Station	Date	Station	Date
FD 371-1	06-77	FD 111-1	05-78	FD 371-1	01-79	FD 371-1	09-80	FD 111-1	03-81	FD 111-1	04-12-88	FD 111-1	04-26-89
FD 371-2	06-77	FD 371-1	05-78	FD 371-2	01-79	FD 371-2	03-80	FD 111-1	09-81	FD 111-1	07-26-88	FD 111-1	06-21-89
FD 444-1	06-77	FD 371-1	06-78	FD 444-1	06-79	FD 371-2	06-80	FD 371-2	03-81	FD 111-1	10-10-88	FD 371 COMP	04-26-89
BS 444-2	06-77	FD 371-2	05-78	FD 444-1	07-79	FD 444-1	03-80	FD 371-3	03-81	FD 371 COMP	04-12-88	FD 371 COMP	09-15-89
FD 516-1	06-77	FD 371-2	06-78	BS 444-2	01-79	FD 444-1	06-80	FD 371-3	09-81	FD 371 COMP	07-26-88	FD 371-3	04-26-89
FD 707-1	06-77	FD 444-1	05-78	FD 516-1	01-79	FD 444-1	09-80	FD 371-5	03-81	FD 371 COMP	10-10-88	FD 371-3	06-21-89
BS 707-2	06-77	FD 444-1	06-78	FD 707-1	01-79	BS 444-2	03-80	FD 707-1	03-81	FD 371 COMP	1988	FD 371-3	09-15-89
BS 771-2	06-77	BS 444-2	05-78	BS 707-2	01-79	BS 444-2	06-80	BS 707-2	03-81	FD 371-3	04-12-88	FD 374	04-13-89
FD 771-4	06-77	BS 444-2	06-78	BS 707-2	07-79	BS 444-2	09-80	BS 707-2	09-81	FD 371-3	10-10-88	DET POND 374	04-13-89
FD 779-1	06-77	FD 516-1	05-78	FD 771-1	06-79	BS 707-2	06-80	BS 707-3	03-81	FD 371-3	12-15-88	374 S DITCH	04-13-89
BS 865-1	06-77	FD 516-1	06-78	FD 771-4	01-79	BS 707-2	09-80	BS 707-3	09-81	FD 516-1	07-26-88	BS 374	05-24-89
FD 883-1	06-77	FD 707-1	05-78	FD 771-4	06-79	FD 516-1	03-80	FD 774-1	09-81	FD 516-1	10-10-88	FD 444-460	04-26-89
BS 881-3	06-77	FD 707-1	06-78	FD 881-1	01-79	FD 516-1	06-80	BS 865-1	03-81	FD 516-1	12-15-88	FD 444	04-25-89
FD 881-1	06-77	BS 707-2	05-78	FD 881-1	07-79	FD 516-1	09-80	FD 883-1	03-81	FD 707-1	04-12-88	FD 444-460	06-21-89
		BS 707-2	06-78	BS 881-3	01-79	FD 707-1	03-80	FD 883-1	09-81	FD 707-1	07-26-88	FD 444-460	09-15-89
		FD 771-1	05-78	FD 883-1	07-79	FD 707-1	06-80	FD 881-1	03-81	FD 707-1	10-10-88	FD 516-1	04-26-89
		FD 771-1	06-78	BS 887-1	07-79	FD 707-1	09-80	FD 881-1	09-81	FD 707-1	12-15-88	FD 516-1	06-21-89
		BS 771-2	05-78			BS 707-3	09-80	BS 881-3	03-81	BS 707-2	07-26-88	FD 516-1	09-15-89
		FD 771-4	05-78			BS 771-2	06-80	BS 881-3	09-81	BS 707-3	04-12-88	CULVERT 559	04-13-89
		FD 771-4	06-78			FD 771-4	03-80			BS 707-3	07-26-88	FD 707-2	06-21-89
		FD 779-1	05-78			FD 771-4	09-80			BS 707-3	10-04-88	BS 707-2	09-15-89
		FD 779-1	06-78			FD 774-1	03-80			BS 707-3	12-15-88	BS 707-3	04-26-89
		BS 865-1	05-78			FD 774-1	06-80			FD 774	05-06-88	BS 707-3	09-15-89
		FD 881-1	05-78			FD 779-1	03-80			FD 779-1	07-26-88	FD 707-1	04-26-89
		FD 881-1	06-78			BS 865-1	03-80			FD 865-1	04-12-88	FD 707-1	06-21-89
		BS 881-2	06-78			BS 865-1	06-80			BS 865-1	07-26-88	FD 707-1	09-15-89
		BS 881-3	05-78			BS 881-3	03-80			BS 865-1	10-04-88	FD 774-1	04-26-89
		BS 881-3	06-78			BS 881-3	06-80			BS 865-1	12-15-88	FD 774-1	06-21-89
		FD 883-1	05-78			BS 881-3	09-80			FD 881-1	04-12-88	FD 774-1	09-15-89
		FD 991-1	05-78			FD 881-1	03-80			FD 881-1	07-26-88	FD 779-1	09-15-89
						FD 881-1	06-80			FD 881-1	10-10-88	BS 865-1	04-26-89
						FD 881-1	09-80			FD 881-1	12-15-88	FD 865-1	06-21-89
						FD 883-1	03-80			BS 881-3	04-12-88	BS 865-1	09-15-89
						FD 883-1	06-80			BS 881-3	07-26-88	FD 881-1	04-26-89
						FD 883-1	09-80			BS 881-3	10-04-88	FD 881-1	06-21-89
						BS 887-1	03-80			BS 881-3	12-15-88	FD 881-1	09-15-89
						FD 991-1	03-80			BS 883-1	04-12-88	BS 881-3	04-26-89
						FD 991-1	06-80			BS 883-1	07-26-88	BS 881-3	06-21-89
						FD 991-1	09-80			BS 883-1	10-04-88	BS 881-3	09-15-89
												BS 883-1	09-15-89
												991 DRAINS	05-02-89
												995 EFF	05-02-89
												995 EFF	05-12-89
												FD 371 COMP	12-17-89
												FD 371-3	12-17-89
												FD 444-460	12-17-89
												FD 516-1	12-17-89
												BS 707-2	12-17-89
												FD 707-1	12-17-89
												FD 774-1	12-17-89
												BS 881-3	12-17-89
												BS 883-1	12-17-89

Table 3 – Foundation Drain and Building Sump Sampling Frequency 1977–1993

1990		1991		1992		1993	
Station	Date	Station	Date	Station	Date	Station	Date
FD 371 COMP	06-08-90	FD 111-1	05-05-91	BS 707-2	3-7-92	BS 111-2	4-28-93
FD 371-3	06-08-90	FD 371 COMP	06-16-91	BS 865-1	3-7-92	BS 707-2	3-27-93
FD 444	06-08-90	FD 371-2	06-16-91	BS 883-1	3-7-92	BS 865-1	3-27-93
FD 444-460	06-08-90	BS 444	01-22-91	FD 111-1	3-7-92	BS 865-2	3-27-93
BS 707-2	06-08-90	FD 444-460	05-05-91	FD 371-3	3-7-92	FD 371-3	3-27-93
FD 707-1	06-08-90	BS 707-2	06-16-91	FD 371-COMP	3-7-92	FD 371-MC	3-27-93
865 TRENCH	01-16-90	FD 707-1	06-16-91	FD 444-460	3-7-92	FD 444-460	3-27-93
865 E. DITCH	03-14-90	BS 865-1	02-28-91	FD 559-561	3-7-92	FD 771-1	5-1-93
865 W DITCH	03-14-90	BS 866-1	05-05-91	FD 707-1	3-7-92	FD 774-1	3-27-93
865 PIT	04-05-90	FD 881-1	02-28-91			FD 883-1	5-1-93
BS 865-1	06-08-90	FD 881-1	05-05-91			FD 886-1	5-1-93
FD 881-1	06-08-90	BS 883-1	05-05-91			FD 886-2	5-1-93
BS 881-3	06-08-90					FD 910	5-1-93
SEEP N OF 881	05-25-90					FD 991-1	4-28-93
SEEP N OF 881	05-25-90						

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Documentation of the sampling of foundation drains and building sumps from 1983 through 1988 was not found during this investigation. It is possible that the foundation drains and sumps were not sampled during that time, although Kirk (1994) recalled that she sampled the foundation drain outfalls and building sumps from 1980 through 1984. Ms. Kirk also recalled that the building sumps and foundation drains were not sampled for approximately two years. The location of the 1982 to 1984 analytical data, if they exist, and the reason for not sampling during 1985 and 1986 are not known

The sampling program was reinstated in 1988. Thirty-nine samples were collected at 13 stations, with major sampling events in April, July, October, and December of that year. The aperiodic sampling continued in 1989. A total of 50 foundation drain and building sump samples were collected at 19 stations in April, June, September, and December. In 1990, 13 samples were collected at six foundation drains, two building sumps, two ditches, and one seep. The building sump and foundation drain samples were collected primarily in June. Records from 1991 indicate that a total of 12 samples were collected from six foundation drains and four building sumps that year.

In recent years, documents and personnel state that sampling will occur quarterly. However, records indicate that most stations are sampled one to two times each year. The *Catalogue of Monitoring Activities* (EG&G 1991) states that samples will be collected quarterly at five sumps (BS-707-2, BS-707-3, BS-865-1, BS-881-3, and BS[FD]-883-1) and 10 foundation drains (FD-111-1, FD-371-3, FD-371-composite, FD-444-460, FD-516-1, FD-707-1, FD-774-1, FD-779-1, FD-850-1, and FD-881-1) and analyzed for gross alpha, gross beta, tritium, nitrate, pH, conductivity, total dissolved solids, and TAL-metals. An internal letter (Barros 1992) recommended that semivolatile and volatile organic analyses be performed to characterize each building sump or foundation drain station. A minimum of three sampling events were proposed to establish a statistical baseline, after which selected sites could be sampled annually or deleted from the sampling program.

Despite these recommendations, foundation drain and building sump sampling has been limited to date. Available data indicate that three building sumps and six foundation drains were sampled for metals, water quality parameters, and radionuclides in 1992. One foundation drain (FD-559-561) was sampled for volatile organic compounds (VOCs) in July 1992.

In 1993, four building sumps and 11 foundation drains were sampled for semivolatile organic compounds (SVOCs) and/or VOCs. Most of this sampling took place in March, April, May, and December Most stations were sampled twice. Four building sumps and 10 foundation drains were sampled for radionuclides and metals that year. Foundation drain and building sump sampling was performed again in March 1994. Fourteen stations were slated for sampling, but at least two of those were dry or inaccessible.

Several sampling stations are commonly dry during the year. Table 4 lists documented sampling stations for which samples could not be obtained because of lack of water or inability to access the sampling station. This information was considered during the development of the recommendations for sampling locations for OU8.

4.2 SAMPLING RESULTS

Analytical results from all known sampling events, through May 1993, are summarized below. Numerical standards for foundation drain and building sump samples have not been developed. In this section metals and radionuclides are compared to the upper tolerance limits (UTLs) for groundwater and surface water, contained in the *Background Geochemical Characterization Report* (EG&G 1993a). The 99/99 UTLs indicate the concentration below which 99 percent of

Table 4 - Foundation Drains and Building Sumps Not Sampled

DATE	LOCATION	REASON
07-26-88	FD 371-2	Dry
07-26-88	FD 371-3	Dry
07-26-88	FD 774-1	Dry
07-26-88	FD 850-1	Dry
10-10-88	FD 371-2	Dry
10-10-88	FD 707-2	Dry
10-10-88	FD 774-1	Dry
10-10-88	FD 779-1	Dry
10-10-88	FD 850-1	Dry
12-15-88	FD 371-2	Dry
12-15-88	FD 774-1	Dry
12-15-88	FD 779-1	Dry
12-15-88	FD 850-1	Dry
12-15-88	BS 707-2	Dry
12-15-88	FD 111-1	Dry
09-15-89	FD 850-1	Dry
09-15-89	FD 111-1	Dry
09-15-89	FD 371-2	Pipe caved in, unable to get sample
12-17-89	BS 707-3	Frozen
12-17-89	BS 865-1	Dry
12-17-89	FD 111-1	Dry
12-17-89	FD 779-1	Dry
12-17-89	FD 850-1	Dry
12-17-89	FD 881-1	No access
06-09-90	BS 707-3	Dry
06-09-90	BS 883-1	Dry
06-09-90	FD 111-1	Dry
06-09-90	FD 516-1	Dry
06-09-90	FD 774-1	Dry
06-09-90	FD 779-1	Dry
06-09-90	FD 850-1	Dry
02-23-91	FD 444-460	Too much mud
02-23-91	FD 111-1	Dry
02-23-91	FD 850-1	Dry
02-23-91	BS 881-3	No access
02-23-91	BS 883-1	Dry
05-05-91	FD 850-1	No reason given
3-13-94	FD 771	Station obscured by mud puddle
3-13-94	FD 779	Low flow

the background surface water or groundwater samples will fall, given a 99 percent probability. This comparison may be useful for identifying storm drains and foundation drains that collect background water and those that collected affected groundwater or surface water.

4.2.1 Metals

Laboratory analysis for metals (arsenic, lead, mercury, potassium, selenium, and thallium) in foundation drain/building sump samples was first performed in 1988 (Table 5). In 1989, ICP screening for aluminum, antimony, barium, beryllium, calcium, cadmium, cobalt, chromium, copper, iron, magnesium, manganese, molybdenum, nickel, silver, sodium, strontium, vanadium, and zinc was added.

Most of the available records do not indicate whether the analytical results are for total or dissolved (unfiltered or filtered) metals. Most of the foundation drain samples were probably analyzed for total metals, based on the fact that the reported metals concentrations are relatively consistent, total dissolved solids concentrations are relatively consistent, and all of the documented samples were analyzed for total metals. Table 5 states whether each sample was analyzed for total or dissolved metals, if known. Samples are currently analyzed for total metals Analytical results for recent (1992 to 1993) sampling for metals is provided in Table 6

Aluminum was detected in all of 78 samples analyzed from 1988 to 1991, at values ranging from 38 to 26,000 micrograms per liter (μg/L). Aluminum concentrations exceeded the background surface water UTL (3,893 μg/L) at FD-371-composite (6,300 μg/L, April 1989), at FD-371-3 (11,000 μg/L in December 1988; 4,700 μg/L in June 1989), at FD-516-1 (19,000 μg/L, October 1988; 26,000 μg/L, April 1989), and at FD-774-1 (14,000 μg/L, April 1989; 5,900 μg/L, June 1989) The background groundwater UTL (12,642 μg/L) was also exceeded at FD-516-1 (October 1988; April 1989) and FD-774-1 (April 1989). Aluminum was detected in all 23 Table

Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID Date Collected Report Date Lab Batch Number	FD 111–1 05–78	FD 111–1 03–81	FD 111–1 09–81	FD 111–1 04–12–88 05–12–88 88 ENV 02467	FD 111–1 07–26–88 11–30–88 88 ENV 02999	FD 111–1 10–10–88 12–06–88 88 ENV 03334	FD 111–1 04–26–89 07–27–89 89 ENV 00822	FD 111–1 06–21–89 08–25–89 89 ENV 01162
Gross Alpha (pCi/L)	9	3	13	31[±21]	3[±8]	5[±14]	7[±12]	9[±14]
Gross Beta (pCi/L)	NA	50	27	–12[±46]	0[±23]	6[±22]	42[±26]	–8[±16]
Tritium (pCi/L)	NA	25	571	NA	NA	NA	NA	NA
Conductivity (µho/cm)	258	355	113	374	400	426	111	381
Total Dissolved Solids	166	159	84	233	228	234	89	243
pH (S U)	7 0	6 7	6 1	7 7	NA	7 4	6 6	7 5
Nitrate as N	3	3 4	5 4	1 7	3 92	1 56	1 79	1 39
Arsenic	NA	NA	NA	NA	<5	<5	<10	<10
Lead	NA	NA	NA	NA	<5	<5	13	5
Mercury	NA	NA	NA	NA	0 4	<0 2	0.3	<0 2
Potassium	NA	NA	NA	NA	2,900	2,800	3,800	4,520
Selenium	NA	NA	NA	NA	<5	<5	<5	<5
Thallium	NA	NA	NA	NA	<10	<10	<1	<10
HSL METALS BY ICP								
Total or Dissolved	Unknown	Unknown	Unknown	Unknown	Total	Total	Unknown	Unknown
Silver	NA	NA	NA	NA	NA	NA	<76	<4 0
Aluminum	NA	NA	NA	NA	NA	NA	1,400	590
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	59	150
Beryllium	NA	NA	NA	NA	NA	NA	<1 0	<2 0
Calcium	NA	NA	NA	NA	NA	NA	14,000	130,000
Cadmium	NA	NA	NA	NA	NA	NA	<5 0	<5 0
Cobalt	NA	NA	NA	NA	NA	NA	<0 20	<29 0
Chromium	NA	NA	NA	NA	NA	NA	<10 0	<9.0
Copper	NA	NA	NA	NA	NA	NA	11	31
Iron	NA	NA	NA	NA	NA	NA	5,000	2,900
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	1,900	8,000
Manganese	NA	NA	NA	NA	NA	NA	320	430
Molybdenum	NA	NA	NA	NA	NA	NA	<22 0	<27 0
Sodium	NA	NA	NA	NA	NA	NA	6,700	25,000
Nickel	NA	NA	NA	NA	NA	NA	<37 0	<22 0
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	<34 0	<50 0
Strontium	NA	NA	NA	NA	NA	NA	78	350
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	42	<34 0
Zinc	NA	NA	NA	NA	NA	NA	340	140

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Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID	FD 111-1	FD 371 COMP	FD 371 COMP	FD 371 COMP	FD 371 COMP	FD 371 COMP	FD 371 COMP	FD 371 COMP
Date Collected	05-05-91	04-12-88	07-26-88	10-10-88	12-15-88	04-26-89	09-15-89	12-17-89
Report Date	05-28-91	05-12-88	11-30-88	12-06-88	2-15-89	07-27-89	11-22-89	04-07-90
Lab Batch Number	91 ENV 00972	88 ENV 02467	88 ENV 02999	88 ENV 03334	88 ENV 03608	89 ENV 00822	89 ENV.01662	E89-3097
Gross Alpha (pCi/L)	2[±1]	42[±21]	41[±19]	33[±23]	9[±15]	14[±18]	50[±22]	10[±11]
Gross Beta (pCi/L)	6[±1]	31[±25]	20[±26]	0[±22]	10[±19]	20[±21]	20[±18]	24[±20]
Tritium (pCi/L)	NA	NA	NA	NA	NA	NA	NA	NA
Conductivity (µho/cm)	146	544	503	686	601	470	563	686
Total Dissolved Solids	102	340	306	399	293	432	366	456
pH (S U)	NA	7 9	NA	7 8	7 9	7 9	7 8	7 8
Nitrate as N	0 74	1 78	1 72	1 29	1 88	1 47	4 37	2 2
Arsenic	NA	NA	<5	<5	<5	<5	<1 0	1,200
Lead	NA	NA	<5	6	<5	8.1	1 8	5 7
Mercury	NA	NA	0 2	<0 2	<0 2	<0 2	<0 2	<0 2
Potassium	NA	NA	2,800	3,400	3,700	2,800	4,190	4,890
Selenium	NA	NA	<5	<5	<5	<5	<1 0	<1 0
Thallium	NA	NA	<10	<10	<5	<1	<1 0	<1 0
HSL METALS BY ICP								
Total or Dissolved	Total	Unknown	Total	Total	Total	Unknown	Total	Total
Silver	<6 0	NA	NA	NA	<7 6	<76	<4 0	<6 0
Aluminum	510	NA	NA	NA	460	6,300	1,900	2,600
Arsenic	<131	NA	NA	NA	NA	NA	NA	NA
Barium	46	NA	NA	NA	130	150	130	190
Beryllium	<1 0	NA	NA	NA	<1.0	<1 0	<2 0	<1 0
Calcium	15,000	NA	NA	NA	83,000	76,000	73,000	90,000
Cadmium	<3 0	NA	NA	NA	<5 0	<5 0	<5 0	<4 0
Cobalt	<4 0	NA	NA	NA	<22 0	<0 20	<29 0	<13 0
Chromium	<7 0	NA	NA	NA	16	10	<9 0	<7 0
Copper	<9 0	NA	NA	NA	<6 3	7 0	16	31
Iron	490	NA	NA	NA	600	5,300	1,300	4,100
Lead	<73 0	NA	NA	NA	NA	NA	NA	NA
Magnesium	1,800	NA	NA	NA	15,000	14,000	12,000	18,000
Manganese	56	NA	NA	NA	340	270	110	1,100
Molybdenum	<9 0	NA	NA	NA	<22 0	<22 0	<27 0	<24 0
Sodium	11,000	NA	NA	NA	31,000	24,000	27,000	32,000
Nickel	<9 0	NA	NA	NA	<37 0	<37 0	<22 0	<36 0
Potassium	2,500	NA	NA	NA	NA	NA	NA	NA
Selenium	<76 0	NA	NA	NA	NA	NA	NA	NA
Antimony	<34 0	NA	NA	NA	<34 0	41	<50 0	<55 0
Strontium	64	NA	NA	NA	500	440	400	540
Thallium	<164	NA	NA	NA	NA	NA	NA	NA
Vanadium	<10 0	NA	NA	NA	<36 0	<36 0	<34 0	17
Zinc	68	NA	NA	NA	44	81	67	76

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Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID Date Collected Report Date Lab Batch Number	FD 371 COMP 06-09-90 08-27-90 90 ENV 01076	FD 371 COMP 06-15-91 07-19-91 91 ENV 01478	FD 371-1 08-77	FD 371-1 05-78	FD 371-1 08-78	FD 371-1 01-79	FD 371-1 09-80	FD 371-2 08-77	FD 371-2 05-78
Gross Alpha (pCi/L)	12[±3]	11[±4]	31	41	17	35	19	27	13
Gross Beta (pCi/L)	16[±5]	4[±5]	NA	NA	NA	NA	41	NA	NA
Tritium (pCi/L)	NA	NA	NA	NA	NA	NA	512	NA	NA
Conductivity (µho/cm)	627	664	654	422	426	476	208	231	357
Total Dissolved Solids	400	390	432	299	265	316	191	141	236
pH (S U)	NA	NA	7.1	7.4	6.8	7.0	6.6	7.1	7.5
Nitrate as N	1.65	1.6	1	2	1	0.7	1	1	1
Arsenic	1,400	<1.0	NA	NA	NA	NA	NA	NA	NA
Lead	7.3	<1.0	NA	NA	NA	NA	NA	NA	NA
Mercury	0.3	<2.0	NA	NA	NA	NA	NA	NA	NA
Potassium	3,180	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	<0.2	<2.0	NA	NA	NA	NA	NA	NA	NA
Thallium	<1.0	<1.0	NA	NA	NA	NA	NA	NA	NA
HSL METALS BY ICP									
Total or Dissolved	Unknown	Total	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Silver	<3.0	<6.0	NA	NA	NA	NA	NA	NA	NA
Aluminum	140	61	NA	NA	NA	NA	NA	NA	NA
Arsenic	NA	<130	NA	NA	NA	NA	NA	NA	NA
Barium	130	160	NA	NA	NA	NA	NA	NA	NA
Beryllium	<1.0	<1.0	NA	NA	NA	NA	NA	NA	NA
Calcium	79,000	93,000	NA	NA	NA	NA	NA	NA	NA
Cadmium	<5.0	<3.0	NA	NA	NA	NA	NA	NA	NA
Cobalt	<10	<4.0	NA	NA	NA	NA	NA	NA	NA
Chromium	<7.0	<7.0	NA	NA	NA	NA	NA	NA	NA
Copper	<2.0	<9.0	NA	NA	NA	NA	NA	NA	NA
Iron	230	1,300	NA	NA	NA	NA	NA	NA	NA
Lead	NA	<73.0	NA	NA	NA	NA	NA	NA	NA
Magnesium	15,000	16,000	NA	NA	NA	NA	NA	NA	NA
Manganese	110	650	NA	NA	NA	NA	NA	NA	NA
Molybdenum	<17.0	<9.0	NA	NA	NA	NA	NA	NA	NA
Sodium	27,000	23,000	NA	NA	NA	NA	NA	NA	NA
Nickel	<36.0	<9.0	NA	NA	NA	NA	NA	NA	NA
Potassium	NA	3,600	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	<76.0	NA	NA	NA	NA	NA	NA	NA
Antimony	<45.0	<34.0	NA	NA	NA	NA	NA	NA	NA
Strontium	450	560	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	<164	NA	NA	NA	NA	NA	NA	NA
Vanadium	<17.0	<10.0	NA	NA	NA	NA	NA	NA	NA
Zinc	35	11	NA	NA	NA	NA	NA	NA	NA

Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID	FD 371-2	FD 371-2	FD 371-2	FD 371-2	FD 371-2	FD 371-2	FD 371-3	FD 371-3	FD 371-3
Date Collected	08-78	01-79	03-80	06-80	03-81	06-15-91	03-81	09-81	04-12-88
Report Date						07-19-91			05-12-88
Lab Batch Number						91 ENV 01478			88 ENV.02467
Gross Alpha (pCi/L)	31	33	17	8	9	27[±2]	12	22	54[±25]
Gross Beta (pCi/L)	NA	NA	9	26	-19	4[±1]	0	11	26[±25]
Tritium (pCi/L)	NA	NA	526	488	205	NA	768	-99	NA
Conductivity (µho/cm)	847	667	588	625	735	700	543	732	522
Total Dissolved Solids	583	424	380	412	340	427	281	471	309
pH (S U)	7 2	7 2	7 1	7 6	7 7	NA	7 8	7 7	7 9
Nitrate as N	2	0 7	3 3	1	1 7	1 46	6 6	1 4	1 29
Arsenic	NA	NA	NA	NA	NA	<1 0	NA	NA	NA
Lead	NA	NA	NA	NA	NA	<1 0	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	<2 0	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	<2 0	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	<1 0	NA	NA	NA
HSL METALS BY ICP									
Total or Dissolved	Unknown	Unknown	Unknown	Unknown	Unknown	Total	Unknown	Unknown	Unknown
Silver	NA	NA	NA	NA	NA	<6 0	NA	NA	NA
Aluminum	NA	NA	NA	NA	NA	88	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	<130	NA	NA	NA
Barium	NA	NA	NA	NA	NA	140	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	<1 0	NA	NA	NA
Calcium	NA	NA	NA	NA	NA	65,000	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA	<3 0	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA	<4 0	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	<7 0	NA	NA	NA
Copper	NA	NA	NA	NA	NA	<9 0	NA	NA	NA
Iron	NA	NA	NA	NA	NA	1,100	NA	NA	NA
Lead	NA	NA	NA	NA	NA	<73.0	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	14,000	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	370	NA	NA	NA
Molybdenum	NA	NA	NA	NA	NA	<9.0	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	54,000	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	<9 0	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	3,200	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	<76 0	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	<34 0	NA	NA	NA
Strontium	NA	NA	NA	NA	NA	440	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	<164	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	<10 0	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	150	NA	NA	NA

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Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID	FD 371-3	FD 371-3	FD 371-3	FD 371-3	FD 371-3	FD 371-3	FD 371-3	FD 371-5
Date Collected	10-10-88	12-15-88	04-26-89	06-21-89	09-15-89	12-17-89	06-09-90	03-81
Report Date	12-06-88	2-15-89	07-27-89	08-25-89	11-22-89	04-07-90	08-27-90	
Lab Batch Number	88 ENV.03334	88.ENV 03608	89 ENV 00822	89 ENV.01162	89 ENV 01662	E89-3097	90 ENV 01076	
Gross Alpha (pCi/L)	34[±21]	49[±26]	10[±18]	49[±22]	14[±12]	31[±18]	17[±2]	27
Gross Beta (pCi/L)	5[±22]	52[±24]	25[±23]	24[±20]	10[±20]	17[±19]	20[±4]	-6
Tritium (pCi/L)	NA	NA	NA	NA	NA	NA	NA	911
Conductivity (µho/cm)	693	743	592	564	622	742	621	331
Total Dissolved Solids	400	315	407	385	398	518	382	139
pH (S U)	7.4	7.5	7.7	8.3	7.1	7.7	NA	8.9
Nitrate as N	0.72	0.43	1.03	1.7	2.65	1.46	1.08	2.0
Arsenic	<5	12.5	<5	<10	37.8	19	1,400	NA
Lead	18	5	2.5	110	11.3	6.9	4.4	NA
Mercury	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	NA
Potassium	5,000	5,700	3,500	4,570	2,840	6,150	3,600	NA
Selenium	<5	<5	<5	<5	3.4	<1.0	<0.2	NA
Thallium	<10	<5	<1	<10	<1.0	<1.0	<1.0	NA
HSL METALS BY ICP								
Total or Dissolved	Total	Total	Unknown	Unknown	Total	Total	Unknown	Unknown
Silver	NA	<7.6	<76	<4.0	<4.0	<6.0	NA	NA
Aluminum	NA	11,000	160	4,700	1,800	640	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	790	140	170	1,700	580	NA	NA
Beryllium	NA	<1.0	<1.0	<2.0	<2.0	<1.0	NA	NA
Calcium	NA	170,000	83,000	77,000	110,000	100,000	NA	NA
Cadmium	NA	<5.0	<5.0	<5.0	<5.0	<4.0	NA	NA
Cobalt	NA	<22.0	<0.20	<29.0	<29.0	<13.0	NA	NA
Chromium	NA	33	<10.0	<9.0	15	<7.0	NA	NA
Copper	NA	12	<6.3	6.7	11	20	NA	NA
Iron	NA	64,000	1,500	6,000	740,000	95,000	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	28,000	15,000	15,000	15,000	19,000	NA	NA
Manganese	NA	14,000	270	240	3,200	3,200	NA	NA
Molybdenum	NA	<22.0	<22.0	<27.0	66	<24.0	NA	NA
Sodium	NA	27,000	29,000	29,000	17,000	40,000	NA	NA
Nickel	NA	<37.0	<37.0	<22.0	<22.0	<36.0	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	<34.0	34.6	<50.0	<50.0	<55.0	NA	NA
Strontium	NA	1,100	540	470	950	730	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	<36.0	<36.0	<34.0	78	<15.0	NA	NA
Zinc	NA	82	49	220	170	140	NA	NA

Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID Date Collected Report Date Lab Batch Number	FD 374 04-13-89 04-28-89 89 ENV 00732	DET POND 374 04-13-89 04-28-89 89 ENV 00733	374 S DITCH 04-13-89 04-28-89 89 ENV 00733	BS 374 05-24-89 05-26-89 E89-992	FD 444-1 08-77	FD 444-1 05-78	FD 444-1 08-78	FD 444-1 06-79
Gross Alpha (pCi/L)	24[±14]	0[±8]	10[±10]	17[±15]	31	13	23	5
Gross Beta (pCi/L)	31[±17]	34[±17]	13[±15]	100[±30]	NA	NA	NA	5
Tritium (pCi/L)	NA	NA	NA	NA	NA	NA	NA	NA
Conductivity (µho/cm)	NA	NA	NA	NA	513	382	228	476
Total Dissolved Solids	NA	NA	NA	NA	342	259	164	354
pH (S U)	NA	NA	NA	NA	6 8	7 7	6 6	7 5
Nitrate as N	0 98	NA	NA	25 – 30	4	6	3	5
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
HSL METALS BY ICP								
Total or Dissolved	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Silver	NA	NA	NA	<0 02	NA	NA	NA	NA
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	<0 1	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA
Strontium	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA

Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID Date Collected Report Date Lab Batch Number	FD 444-1 07-79	FD 444-1 03-80	FD 444-1 06-80	FD 444-1 09-80	BS 444-2 08-77	BS 444-2 05-78	BS 444-2 08-78	BS 444-2 01-79
Gross Alpha (pCi/L)	5	2	13	6	34	58	28	17
Gross Beta (pCi/L)	NA	6	8	2	NA	NA	NA	NA
Tritium (pCi/L)	NA	518	483	430	NA	NA	NA	NA
Conductivity (µmho/cm)	541	500	465	308	241	370	559	400
Total Dissolved Solids	386	343	354	211	190	313	422	290
pH (S U)	6 9	7 8	7 1	6 9	7 0	7 3	7 5	7 4
Nitrate as N	5 2	5 5	4 5	1	5	7	6	1
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
HSL METALS BY ICP								
Total or Dissolved	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Silver	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA
Strontium	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA

Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID / Date Collected / Report Date / Lab Batch Number	BS 444-2 03-80	BS 444-2 06-80	BS 444-2 09-80	BS 444 01-22-91 03-15-90 90 ENV 00315	FD 444-460 04-26-89 07-27-89 89 ENV 00822	FD 444 04-25-89 05-05-89 89 ENV 00833	FD 444-460 06-21-89 08-25-89 89 ENV 01162	FD 444-460 09-15-89 11-22-89 89 ENV 01662
Gross Alpha (pCi/L)	14	18	18	350[±20]	1[±9]	NA	1[±10]	32[±16]
Gross Beta (pCi/L)	43	22	-5	760[±40]	4[±19]	NA	4[±18]	1[±16]
Tritium (pCi/L)	528	740	438	NA	NA	NA	NA	NA
Conductivity (μho/cm)	625	690	1,160	NA	275	NA	489	547
Total Dissolved Solids	411	524	1,028	NA	203	NA	431	408
pH (S U)	8 0	8 3	9 2	NA	7 5	NA	8 7	8 4
Nitrate as N	6 1	14 9	53 8	8 28	3 36	NA	7 3	7 39
Arsenic	NA	NA	NA	NA	<10	NA	<10	<1 0
Lead	NA	NA	NA	278	19	NA	8	9 1
Mercury	NA	NA	NA	<0 2	<0 2	NA	<0 2	<0 2
Potassium	NA	NA	NA	NA	3,700	NA	1,560	2,860
Selenium	NA	NA	NA	NA	<5	NA	<5	<1 0
Thallium	NA	NA	NA	<1 0	<1	NA	<10	<1 0
HSL METALS BY ICP								
Total or Dissolved	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Total
Silver	NA	NA	NA	NA	<76	NA	<4 0	<4 0
Aluminum	NA	NA	NA	NA	1,600	NA	970	1,900
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	87	NA	150	150
Beryllium	NA	NA	NA	NA	<1 0	NA	<2 0	<2 0
Calcium	NA	NA	NA	NA	42,000	NA	84,000	88,000
Cadmium	NA	NA	NA	NA	<5 0	NA	<5 0	<5 0
Cobalt	NA	NA	NA	NA	<0 20	NA	<29 0	<29 0
Chromium	NA	NA	NA	NA	130	13,000	<9.0	<9.0
Copper	NA	NA	NA	NA	81	NA	130	47
Iron	NA	NA	NA	NA	1,600	NA	3,400	1,500
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	4,800	NA	11,000	11,000
Manganese	NA	NA	NA	NA	89	NA	66	38
Molybdenum	NA	NA	NA	NA	<22 0	NA	<27 0	<27 0
Sodium	NA	NA	NA	NA	18,000	NA	13,000	14,000
Nickel	NA	NA	NA	NA	<37 0	NA	<22 0	<22 0
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	<34 0	NA	<50 0	<50 0
Strontium	NA	NA	NA	NA	200	NA	380	380
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	<36 0	NA	<34 0	<34 0
Zinc	NA	NA	NA	NA	1,700	NA	600.00	480

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Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID	FD 444–460	FD 444	FD 444–460	FD 444–460	FD 516–1	FD 516–1	FD 516–1	FD 516–1
Date Collected	12–17–89	05–03–90	06–09–90	05–05–91	08–77	05–78	08–78	01–79
Report Date	04–07–90	07–30–90	08–27–90	05–28–91				
Lab Batch Number	E89–3097	90 ENV 00770	90 ENV 01076	91 ENV 00972				
Gross Alpha (pCi/L)	16[±15]	25[±3]	2[±2]	3[±1]	21	12	20	14
Gross Beta (pCi/L)	19[±19]	12[±3]	7[±4]	6[±1]	NA	NA	NA	NA
Tritium (pCi/L)	NA	NA	NA	NA	NA	NA	NA	NA
Conductivity (μho/cm)	523	470	600	25.5	375	408	427	1,429
Total Dissolved Solids	398	NA	450	11	276	326	346	832
pH (S.U.)	8.5	7.9	NA	NA	6.8	7.5	7.2	7.1
Nitrate as N	7.26	5.94	7.34	0.31	5	14	9	4.1
Arsenic	<1.0	1.1	<1.0	NA	NA	NA	NA	NA
Lead	20	3.3	5.1	NA	NA	NA	NA	NA
Mercury	<0.2	<0.2	<0.2	NA	NA	NA	NA	NA
Potassium	1540	11,000	1,440	NA	NA	NA	NA	NA
Selenium	<1.0	<2.0	<0.2	NA	NA	NA	NA	NA
Thallium	<1.0	<1.0	<1.0	NA	NA	NA	NA	NA
HSL METALS BY ICP								
Total or Dissolved	Total	Unknown	Unknown	Total	Unknown	Unknown	Unknown	Unknown
Silver	<6.0	Unknown	<3.0	<6.0	NA	NA	NA	NA
Aluminum	1,800	Unknown	48	27	NA	NA	NA	NA
Arsenic	NA	NA	NA	<131	NA	NA	NA	NA
Barium	170	Unknown	140	11	NA	NA	NA	NA
Beryllium	<1.0	Unknown	<1.0	2.5	NA	NA	NA	NA
Calcium	88,000	Unknown	89,000	2,700	NA	NA	NA	NA
Cadmium	<4.0	Unknown	<5.0	<3.0	NA	NA	NA	NA
Cobalt	<13.0	Unknown	<10	<4.0	NA	NA	NA	NA
Chromium	8.3	Unknown	<7.0	<7.0	NA	NA	NA	NA
Copper	190	Unknown	<2.0	15	NA	NA	NA	NA
Iron	4,100	Unknown	71	230	NA	NA	NA	NA
Lead	NA	NA	NA	<73.0	NA	NA	NA	NA
Magnesium	12,000	Unknown	12,000	380	NA	NA	NA	NA
Manganese	100	Unknown	38	10	NA	NA	NA	NA
Molybdenum	<24.0	NA	<17.0	<9.0	NA	NA	NA	NA
Sodium	14,000	Unknown	11,000	2,700	NA	NA	NA	NA
Nickel	36	Unknown	<36.0	<9.0	NA	NA	NA	NA
Potassium	NA	NA	NA	1,200	NA	NA	NA	NA
Selenium	NA	NA	NA	<76.0	NA	NA	NA	NA
Antimony	<55.0	Unknown	<45.0	<34.0	NA	NA	NA	NA
Strontium	410	NA	390	13	NA	NA	NA	NA
Thallium	NA	NA	NA	<164	NA	NA	NA	NA
Vanadium	<15.0	Unknown	<17.0	<10.0	NA	NA	NA	NA
Zinc	1,100	Unknown	180	370	NA	NA	NA	NA

Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID Date Collected Report Date Lab Batch Number	FD 516-1 03-80	FD 516-1 06-80	FD 516-1 09-80	FD 516-1 07-26-88 11-30-88 88 ENV 02999	FD 516-1 10-10-88 12-06-88 88 ENV 03334	FD 516-1 12-15-88 2-15-89 88 ENV 03608	FD 516-1 04-26-89 07-27-89 89 ENV 00622	FD 516-1 06-21-89 08-25-89 89 ENV 01162
Gross Alpha (pCi/L)	18	3	4	3[±9]	0[±14]	5[±12]	12[±17]	10[±12]
Gross Beta (pCi/L)	28	43	16	6[±23]	-5[±27]	6[±13]	13[±21]	3[±18]
Tritium (pCi/L)	549	1,308	728	NA	NA	NA	NA	NA
Conductivity (µmho/cm)	540	525	476	412	605	548	482	488
Total Dissolved Solids	359	462	341	258	357	403	361	354
pH (S U)	8.3	7.8	7.9	NA	7.9	8.2	8.0	8.4
Nitrate as N	6.8	5	6.2	3.42	3.19	5.14	4.34	5.70
Arsenic	NA	NA	NA	<5	<5	<5	4	<10
Lead	NA	NA	NA	<5	62	<5	48	15
Mercury	NA	NA	NA	0.7	80	3.4	14	1.4
Potassium	NA	NA	NA	1,700	4,800	1,400	4,900	1,760
Selenium	NA	NA	NA	<5	<5	<5	<5	<5
Thallium	NA	NA	NA	<10	<10	<5	<1	<10
HSL METALS BY ICP								
Total or Dissolved	Unknown	Unknown	Unknown	Total	Total	Total	Unknown	Unknown
Silver	NA	NA	NA	NA	<7.6	<7.6	<76	<4.0
Aluminum	NA	NA	NA	NA	19,000	1,600	26,000	2,300
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	310	130	320	120
Beryllium	NA	NA	NA	NA	<1.0	<1.0	>1.0	<2.0
Calcium	NA	NA	NA	NA	200,000	94,000	130,000	72,000
Cadmium	NA	NA	NA	NA	<5.0	<5.0	<5.0	<5.0
Cobalt	NA	NA	NA	NA	<22.0	<22.0	<0.20	<29.0
Chromium	NA	NA	NA	NA	35	24	0.0308	<9.0
Copper	NA	NA	NA	NA	32	7.0	58	5.8
Iron	NA	NA	NA	NA	15,000	1,300	24,000	2,100
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	15,000	13,000	18,000	11,000
Manganese	NA	NA	NA	NA	290	29	330	71
Molybdenum	NA	NA	NA	NA	<22.0	<22.0	<22.0	<27.0
Sodium	NA	NA	NA	NA	20,000	25,000	22,000	18,000
Nickel	NA	NA	NA	NA	<37.0	<37.0	<37.0	<22.0
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	<34.0	<34.0	34	<50.0
Strontium	NA	NA	NA	NA	600	460	50	350
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	50	<36.0	68	<34.0
Zinc	NA	NA	NA	NA	1,400	140	1,900	200,00

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Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID	FD 516–1	FD 516–1	CULVERT 559	FD 707–1	FD 707–1	FD 707–1	FD 707–1	FD 707–1
Date Collected	09–15–89	12–17–89	04–13–89	08–77	05–78	06–78	01–79	03–80
Report Date	11–22–89	04–07–90	04–28–89					
Lab Batch Number	89 ENV 01662	E89–3097	89 ENV 00732					
Gross Alpha (pCi/L)	7[±12]	10[±12]	9[±10]	64	26	29	33	9
Gross Beta (pCi/L)	–8[±16]	14[±17]	34[±19]	NA	NA	NA	NA	12
Tritium (pCi/L)	NA	NA	NA	NA	NA	NA	NA	1,248
Conductivity (µmho/cm)	519	547	NA	699	513	763	1,282	757
Total Dissolved Solids	331	378	NA	514	348	493	731	440
pH (S U)	8 4	8 3	NA	7 6	7 6	7 0	7 0	7 8
Nitrate as N	6 65	4 94	4 15	19	4	2	1 5	1 4
Arsenic	1	<1 0	NA	NA	NA	NA	NA	NA
Lead	2 1	10 4	NA	NA	NA	NA	NA	NA
Mercury	0 6	2.1	NA	NA	NA	NA	NA	NA
Potassium	1,400	1,860	NA	NA	NA	NA	NA	NA
Selenium	<1 0	<1 0	NA	NA	NA	NA	NA	NA
Thallium	<1 0	<1 0	NA	NA	NA	NA	NA	NA
HSL METALS BY ICP								
Total or Dissolved	Total	Total	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Silver	<4 0	<6 0	NA	NA	NA	NA	NA	NA
Aluminum	57	3,500	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	950	140	NA	NA	NA	NA	NA	NA
Beryllium	<2 0	<1.0	NA	NA	NA	NA	NA	NA
Calcium	72,000	85,000	NA	NA	NA	NA	NA	NA
Cadmium	<5 0	<4 0	NA	NA	NA	NA	NA	NA
Cobalt	<29 0	<13 0	NA	NA	NA	NA	NA	NA
Chromium	<9 0	9.4	NA	NA	NA	NA	NA	NA
Copper	<4 0	18	NA	NA	NA	NA	NA	NA
Iron	110	3,200	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	9,800	13,000	NA	NA	NA	NA	NA	NA
Manganese	<2 0	81	NA	NA	NA	NA	NA	NA
Molybdenum	<27 0	<24 0	NA	NA	NA	NA	NA	NA
Sodium	20,000	21,000	NA	NA	NA	NA	NA	NA
Nickel	<22 0	<36 0	NA	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	<50 0	<55 0	NA	NA	NA	NA	NA	NA
Strontium	330	400 00	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	<34 0	<15 0	NA	NA	NA	NA	NA	NA
Zinc	62	180	NA	NA	NA	NA	NA	NA

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Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID / Date Collected / Report Date / Lab Batch Number	FD 707-1 06-80	FD 707-1 09-80	FD 707-1 03-81	FD 707-1 04-12-88 05-12-88 88 ENV 02467	FD 707-1 07-26-88 11-30-88 88 ENV 02999	FD 707-1 10-10-88 12-06-88 88 ENV 03334	FD 707-1 12-15-88 2-15-89 88 ENV 03608	FD 707-1 04-26-89 07-27-89 89 ENV 00822
Gross Alpha (pCi/L)	13	9	-8	29[±18]	6[±11]	14[±17]	5[±11]	15[±17]
Gross Beta (pCi/L)	31	5	10	43[±27]	4[±24]	1[±22]	3[±18]	9[±21]
Tritium (pCi/L)	596	514	719	NA	NA	NA	NA	NA
Conductivity (µho/cm)	555	392	560	741	647	787	684	853
Total Dissolved Solids	324	276	507	453	387	477	450	484
pH (S U)	7 8	7 0	8 2	8 0	NA	7 9	8 0	7 8
Nitrate as N	1 4	1	1 2	1 92	1 27	1 12	1.10	2 3
Arsenic	NA	NA	NA	NA	<5	<5	5	<5
Lead	NA	NA	NA	NA	<5	<5	<5	2 5
Mercury	NA	NA	NA	NA	<0 2	<0 2	<0 2	<0 2
Potassium	NA	NA	NA	NA	3,200	4,000	5,100	2,800
Selenium	NA	NA	NA	NA	<5	<5	<5	<5
Thallium	NA	NA	NA	NA	<10	<10	NA	<1
HSL METALS BY ICP								
Total or Dissolved	Unknown	Unknown	Unknown	Unknown	Total	Total	Total	Unknown
Silver	NA	NA	NA	NA	NA	NA	<7 6	<76
Aluminum	NA	NA	NA	NA	NA	NA	450	170
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	130	180
Beryllium	NA	NA	NA	NA	NA	NA	<1.0	<1.0
Calcium	NA	NA	NA	NA	NA	NA	65,000	100,000
Cadmium	NA	NA	NA	NA	NA	NA	<5 0	<5 0
Cobalt	NA	NA	NA	NA	NA	NA	<22 0	<0 20
Chromium	NA	NA	NA	NA	NA	NA	12	<10 0
Copper	NA	NA	NA	NA	NA	NA	<6 3	<6 3
Iron	NA	NA	NA	NA	NA	NA	1800	1,700
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	15,000	24,000
Manganese	NA	NA	NA	NA	NA	NA	740	1,000
Molybdenum	NA	NA	NA	NA	NA	NA	<22 0	<22.0
Sodium	NA	NA	NA	NA	NA	NA	70,000	70,000
Nickel	NA	NA	NA	NA	NA	NA	<37 0	<37 0
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	<34 0	45
Strontium	NA	NA	NA	NA	NA	NA	570	790
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	<36 0	<36 0
Zinc	NA	NA	NA	NA	NA	NA	130	240

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Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID	FD 707-1	FD 707-1	FD 707-1	FD 707-1	FD 707-1	BS 707-2	BS 707-2	BS 707-2
Date Collected	06-21-89	09-15-89	12-17-89	06-09-90	06-15-91	08-77	05-78	08-78
Report Date	08-25-89	11-22-89	04-07-90	08-27-90	07-19-91			
Lab Batch Number	89 ENV 01162	89 ENV 01662	E89-3097	90 ENV 01076	91 ENV 01478			
Gross Alpha (pCi/L)	7[±12]	18[±13]	10[±13]	9[±4]	5[±3]	31	40	63
Gross Beta (pCi/L)	29[±22]	11[±18]	17[±19]	26[±9]	8[±4]	NA	NA	NA
Tritium (pCi/L)	NA	NA	NA	NA	NA	NA	NA	NA
Conductivity (µmho/cm)	709	553	775	2380	733	667	667	952
Total Dissolved Solids	458	342	520	1,440	436	482	516	682
pH (S U)	8 3	8 2	7 9	NA	NA	7 5	8 0	7 7
Nitrate as N	2 85	3 55	1 76	9 06	3 64	2	1	3
Arsenic	<10	1 2	1 2	6.3	1 8	NA	NA	NA
Lead	<5	5 4	4 1	7 0	<1 0	NA	NA	NA
Mercury	<0 2	<0 2	<0.2	<0 2	<2 0	NA	NA	NA
Potassium	4,100	4,120	15,400	29,000	NA	NA	NA	NA
Selenium	<5	<1 0	<1 0	3 2	<2 0	NA	NA	NA
Thallium	<10	<1 0	<1 0	<1 0	<1 0	NA	NA	NA
HSL METALS BY ICP								
Total or Dissolved	Unknown	Total	Total	Unknown	Total	Unknown	Unknown	Unknown
Silver	<4 0	<4 0	<6 0	<3 0	<6 0	NA	NA	NA
Aluminum	170	540	960	210	74	NA	NA	NA
Arsenic	NA	NA	NA	NA	<130	NA	NA	NA
Barium	130	150	110	310	140	NA	NA	NA
Beryllium	<2 0	<2 0	<1 0	<1 0	<1 0	NA	NA	NA
Calcium	65,000	71,000	74,000	110,000	81,000	NA	NA	NA
Cadmium	<5 0	<5 0	<4 0	<5 0	<3 0	NA	NA	NA
Cobalt	<29 0	<29 0	<13 0	<10	<4 0	NA	NA	NA
Chromium	<9 0	<9 0	<7 0	<7 0	<7 0	NA	NA	NA
Copper	4 9	4 3	19	<2 0	<9 0	NA	NA	NA
Iron	790	750	2,100	2,200	77	NA	NA	NA
Lead	NA	NA	NA	NA	<73 0	NA	NA	NA
Magnesium	18,000	14,000	11,000	18,000	14,000	NA	NA	NA
Manganese	270	250	500	480	110	NA	NA	NA
Molybdenum	<27 0	<27 0	<24 0	29	<9 0	NA	NA	NA
Sodium	62,000	40,000	61,000	360,000	30,000	NA	NA	NA
Nickel	<22 0	<22 0	36	<36 0	<9 0	NA	NA	NA
Potassium	NA	NA	NA	NA	3,000	NA	NA	NA
Selenium	NA	NA	NA	NA	<76 0	NA	NA	NA
Antimony	<50 0	<50 0	<55 0	<45 0	<34 0	NA	NA	NA
Strontium	580	500	870	1,100	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	<164	NA	NA	NA
Vanadium	<34 0	42	17	23	<10 0	NA	NA	NA
Zinc	78	110	150	200	20	NA	NA	NA

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Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID / Date Collected / Report Date / Lab Batch Number	BS 707-2 01-79	BS 707-2 07-79	BS 707-2 06-80	BS 707-2 09-80	BS 707-2 03-81	BS 707-2 09-81	BS 707-2 07-26-88 11-30-88 88 ENV 02999	FD 707-2 06-21-89 08-25-89 89 ENV 01162
Gross Alpha (pCi/L)	44	29	16	2	33	20	18[±13]	6[±11]
Gross Beta (pCi/L)	NA	NA	34	34	63	28	41[±27]	12[±19]
Tritium (pCi/L)	NA	NA	573	467	652	174	NA	NA
Conductivity (µho/cm)	909	800	1,250	1,820	1,250	402	501	340
Total Dissolved Solids	695	563	976	1,527	793	298	332	254
pH (S U)	7 3	8 3	6 4	7 7	8 0	7 8	NA	8 8
Nitrate as N	1 2	1 8	5 2	16 0	2 5	2 7	12 7	1 97
Arsenic	NA	NA	NA	NA	NA	NA	43	26
Lead	NA	NA	NA	NA	NA	NA	15	63
Mercury	NA	NA	NA	NA	NA	NA	<0 2	<0.2
Potassium	NA	NA	NA	NA	NA	NA	32,000	37,840
Selenium	NA	NA	NA	NA	NA	NA	<5	<5
Thallium	NA	NA	NA	NA	NA	NA	<10	<10
HSL METALS BY ICP								
Total or Dissolved	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Total	Unknown
Silver	NA	NA	NA	NA	NA	NA	NA	<4 0
Aluminum	NA	NA	NA	NA	NA	NA	NA	2,900
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	89
Beryllium	NA	NA	NA	NA	NA	NA	NA	<2 0
Calcium	NA	NA	NA	NA	NA	NA	NA	20,000
Cadmium	NA	NA	NA	NA	NA	NA	NA	12
Cobalt	NA	NA	NA	NA	NA	NA	NA	<29 0
Chromium	NA	NA	NA	NA	NA	NA	NA	15
Copper	NA	NA	NA	NA	NA	NA	NA	110
Iron	NA	NA	NA	NA	NA	NA	NA	4,200
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	2,800
Manganese	NA	NA	NA	NA	NA	NA	NA	17
Molybdenum	NA	NA	NA	NA	NA	NA	NA	<27 0
Sodium	NA	NA	NA	NA	NA	NA	NA	45,000
Nickel	NA	NA	NA	NA	NA	NA	NA	<22 0
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	<50 0
Strontium	NA	NA	NA	NA	NA	NA	NA	100
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	<34 0
Zinc	NA	NA	NA	NA	NA	NA	NA	1,500

Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID	BS 707–2	BS 707–2	BS 707–2	BS 707–2	BS 707–3	BS 707–3	BS 707–3	BS 707–3
Date Collected	09–15–89	12–17–89	06–09–90	06–15–91	09–80	03–81	09–81	04–12–88
Report Date	11–22–89	04–07–90	08–27–90	07–17–91				05–12–88
Lab Batch Number	89 ENV 01662	E89–3097	90 ENV 01076	91 ENV 01477				88 ENV 02467
Gross Alpha (pCi/L)	5[±9]	9[±14]	12[±12]	3[±2]	68	66	7,900	9[±18]
Gross Beta (pCi/L)	32[±20]	29[±15]	29[±4]	4[±3]	182	26	99	37[±43]
Tritium (pCi/L)	NA	NA	NA	NA	522	532	548	NA
Conductivity (µho/cm)	354	544	985	327	2,220	990	1,336	728
Total Dissolved Solids	246	440	738	224	1,328	493	806	354
pH (S U)	9	8.3	NA	NA	9.6	9.3	9.7	10.7
Nitrate as N	1.96	2.17	3.45	1.05	2.2	1.8	5.9	NA
Arsenic	26.7	222	97.2	19	NA	NA	NA	NA
Lead	6.1	3	17.2	<1	NA	NA	NA	NA
Mercury	<0.2	<0.2	0.3	<0.2	NA	NA	NA	NA
Potassium	41,900	14,900	26,600	NA	NA	NA	NA	NA
Selenium	<1.0	3.1	<0.2	<2	NA	NA	NA	NA
Thallium	<1.0	1.1	<1.0	<1	NA	NA	NA	NA
HSL METALS BY ICP								
Total or Dissolved	Total	Total	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Silver	<4.0	<6.0	<3.0	<6.0	NA	NA	NA	NA
Aluminum	100	590	1,500	96	NA	NA	NA	NA
Arsenic	NA	NA	NA	<130	NA	NA	NA	NA
Barium	7.8	20	47	6.9	NA	NA	NA	NA
Beryllium	<2.0	<1.0	<1.0	<1.0	NA	NA	NA	NA
Calcium	14,000	42,000	93,000	16,000	NA	NA	NA	NA
Cadmium	<5.0	<4.0	6.5	<3.0	NA	NA	NA	NA
Cobalt	<29.0	<13.0	<10	<4.0	NA	NA	NA	NA
Chromium	<9.0	13	<7.0	<7.0	NA	NA	NA	NA
Copper	27	99	70	15	NA	NA	NA	NA
Iron	100	470	1,500	58	NA	NA	NA	NA
Lead	NA	NA	NA	<73.0	NA	NA	NA	NA
Magnesium	1,700	9,900	22,000	2,500	NA	NA	NA	NA
Manganese	6.4	27	87	4.8	NA	NA	NA	NA
Molybdenum	<27.0	<24.0	22	<9.0	NA	NA	NA	NA
Sodium	40,000	54,000	88,000	38,000	NA	NA	NA	NA
Nickel	<22.0	<36.0	<36.0	<9.0	NA	NA	NA	NA
Potassium	NA	NA	NA	24,000	NA	NA	NA	NA
Selenium	NA	NA	NA	<76.0	NA	NA	NA	NA
Antimony	<50.0	<55.0	<45.0	<34.0	NA	NA	NA	NA
Strontium	74	210	440	70	NA	NA	NA	NA
Thallium	NA	NA	NA	<164	NA	NA	NA	NA
Vanadium	<34.0	<15.0	<17.0	<10.0	NA	NA	NA	NA
Zinc	54	45	250	42	NA	NA	NA	NA

Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID	BS 707-3	BS 707-3	BS 707-3	BS 707-3	BS 707-3	FD 771-1	FD 771-1	FD 771-1
Date Collected	07-26-88	10-04-88	12-15-88	04-26-89	09-15-89	05-78	08-78	06-79
Report Date	11-30-88	12-06-88	2-15-89	07-27-89	11-22-89			
Lab Batch Number	88 ENV 02999	88 ENV 03310	88 ENV 03608	89 ENV 00822	89 ENV 01662			
Gross Alpha (pCi/L)	20 (±13)	22 (±23)	1 (±10)	20 (±19)	16 (±16)	44	24	31
Gross Beta (pCi/L)	93 (±33)	82 (±29)	60 (±26)	58 (±26)	53 (±23)	NA	NA	5
Tritium (pCi/L)	NA	NA	NA	NA	NA	NA	NA	NA
Conductivity (µmho/cm)	737	779	857	1,150	13,450	77	1,612	1,818
Total Dissolved Solids	332	335	449	697	697	48	1,157	1,433
pH (S U)	NA	10.9	11	10.8	11	7.4	7.2	8.3
Nitrate as N	4.07	0.62	0.55	0.23	0.47	1	13	11
Arsenic	<5	<5	<5	<5	<10	NA	NA	NA
Lead	10	6	<5	9.3	10.2	NA	NA	NA
Mercury	0.2	<0.2	<0.2	<0.2	0.4	NA	NA	NA
Potassium	62,000	68,000	7,500	66,000	83,100	NA	NA	NA
Selenium	<5	<5	<5	<5	<1.0	NA	NA	NA
Thallium	<10	<10	<10	<1	<1.0	NA	NA	NA
HSL METALS BY ICP								
Total or Dissolved	Total	Total	Total	Unknown	Total	Unknown	Unknown	Unknown
Silver	NA	<7.6	<7.6	<76	<4.0	NA	NA	NA
Aluminum	NA	830	1,000	1,100	720	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	<100	<10.0	21	8.8	NA	NA	NA
Beryllium	NA	<1.0	<1.0	<1.0	<2.0	NA	NA	NA
Calcium	NA	6,800	6,400	9,300	4,600	NA	NA	NA
Cadmium	NA	<5.0	<5.0	<5.0	<5.0	NA	NA	NA
Cobalt	NA	<22.0	<22.0	<0.20	<29.0	NA	NA	NA
Chromium	NA	15	<10.0	<10.0	<9.0	NA	NA	NA
Copper	NA	12	9.3	15	9.6	NA	NA	NA
Iron	NA	1,200	1,500	3,400	1,100	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	140	190	330	110	NA	NA	NA
Manganese	NA	12	17	42	13	NA	NA	NA
Molybdenum	NA	<22.0	<22.0	<22.0	<27.0	NA	NA	NA
Sodium	NA	83,000	120,000	230,000	190,000	NA	NA	NA
Nickel	NA	<37.0	<37.0	<37.0	<22.0	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	<34.0	<34.0	<34.0	<50.0	NA	NA	NA
Strontium	NA	210	200	240	170	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	<36.0	<36.0	41	<34.0	NA	NA	NA
Zinc	NA	310	120	330	150	NA	NA	NA

Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID Date Collected Report Date Lab Batch Number	BS 771–2 08–77	BS 771–2 05–78	BS 771–2 06–80	FD 771–4 08–77	FD 771–4 05–78	FD 771–4 08–78	FD 771–4 01–79	FD 771–4 06–79
Gross Alpha (pCi/L)	24	12	18	51	9	17	18	15
Gross Beta (pCi/L)	NA	NA	10	NA	NA	NA	NA	12
Tritium (pCi/L)	NA	NA	926	NA	NA	NA	NA	NA
Conductivity (μho/cm)	588	588	910	800	355	909	400	800
Total Dissolved Solids	415	382	727	566	261	696	256	561
pH (S U)	7 1	8 0	7 8	7 4	7 1	7 4	7 2	7 3
Nitrate as N	10	9	6 1	5	13	4	1	5
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
HSL METALS BY ICP								
Total or Dissolved	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Silver	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA
Strontium	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA

Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID Date Collected Report Date Lab Batch Number	FD 771-4 03-80	FD 771-4 09-80	FD 774-1 03-80	FD 774-1 06-80	FD 774-1 09-81	FD 774 05-06-88 05-17-88 88 ENV 02595	FD 774-1 04-26-89 07-27-89 89 ENV 00822	FD 774-1 06-21-89 08-25-89 89 ENV 01162
Gross Alpha (pCi/L)	2	2	19	42	3	39[±23]	38[±22]	6[±10]
Gross Beta (pCi/L)	13	31	39	53	21	NA	39[±27]	14[±19]
Tritium (pCi/L)	676	539	839	4,681	3,368	NA	NA	NA
Conductivity (μho/cm)	833	667	1,250	1,430	665	NA	538	717
Total Dissolved Solids	667	426	1,021	359	558	NA	443	550
pH (S U)	8 2	7 3	8 1	6 7	7 4	NA	7 7	8 4
Nitrate as N	7 7	1	47	108 5	14 8	14 7	12 1	19 3
Arsenic	NA	NA	NA	NA	NA	NA	5	<10
Lead	NA	NA	NA	NA	NA	NA	363	11
Mercury	NA	NA	NA	NA	NA	NA	0 8	<0 2
Potassium	NA	NA	NA	NA	NA	NA	7,800	7,610
Selenium	NA	NA	NA	NA	NA	NA	<5	6
Thallium	NA	NA	NA	NA	NA	NA	<1	<10
HSL METALS BY ICP								
Total or Dissolved	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Silver	NA	NA	NA	NA	NA	NA	<76	<4 0
Aluminum	NA	NA	NA	NA	NA	NA	14,000	5,900
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	450	170
Beryllium	NA	NA	NA	NA	NA	NA	2 4	<2 0
Calcium	NA	NA	NA	NA	NA	NA	220,000	120,000
Cadmium	NA	NA	NA	NA	NA	NA	20	<5 0
Cobalt	NA	NA	NA	NA	NA	NA	<0 20	<29 0
Chromium	NA	NA	NA	NA	NA	NA	54	12
Copper	NA	NA	NA	NA	NA	NA	360	7 6
Iron	NA	NA	NA	NA	NA	NA	20,000	4,400
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	17,000	14,000
Manganese	NA	NA	NA	NA	NA	NA	61	51
Molybdenum	NA	NA	NA	NA	NA	NA	<22 0	<27 0
Sodium	NA	NA	NA	NA	NA	NA	43,000	47,000
Nickel	NA	NA	NA	NA	NA	NA	71	<22 0
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	<34 0	<50 0
Strontium	NA	NA	NA	NA	NA	NA	700	470
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	68	<34 0
Zinc	NA	NA	NA	NA	NA	NA	7,300	180

Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID	FD 774-1	FD 774-1	FD 779-1	FD 779-1	FD 779-1	FD 779-1	FD 779-1	FD 779-1
Date Collected	09-15-89	12-17-89	08-77	05-78	08-78	03-80	07-26-88	09-15-89
Report Date	11-22-89	04-07-90					11-30-88	11-22-89
Lab Batch Number	89 ENV 01662	E89-3097					88 ENV 02999	89 ENV 01662
Gross Alpha (pCi/L)	20[±14]	13[±12]	42	17	33	31	47[±22]	25[±15]
Gross Beta (pCi/L)	19[±20]	22[±20]	NA	NA	NA	33	41[±26]	12[±19]
Tritium (pCi/L)	NA	NA	NA	NA	NA	3,640	NA	NA
Conductivity (μho/cm)	7,055	307	870	431	1,000	1,020	3,110	664
Total Dissolved Solids	519	199	633	274	690	695	2,762	429
pH (S U)	7 8	8 3	7 5	7 5	7 4	8 3	NA	8 3
Nitrate as N	17 4	5 73	19	10	20	14 2	281	NA
Arsenic	<1 0	1 9	NA	NA	NA	NA	<5	1 5
Lead	9	33 2	NA	NA	NA	NA	<5	2 1
Mercury	<0 2	<0 2	NA	NA	NA	NA	<0 2	<0 2
Potassium	11,380	3,450	NA	NA	NA	NA	19,000	7,500
Selenium	3 7	2 1	NA	NA	NA	NA	<5	<1 0
Thallium	<1 0	<1 0	NA	NA	NA	NA	<10	<1 0
HSL METALS BY ICP								
Total or Dissolved	Total	Total	Unknown	Unknown	Unknown	Unknown	Total	Total
Silver	<4 0	<6 0	NA	NA	NA	NA	NA	<4 0
Aluminum	220	3,700	NA	NA	NA	NA	NA	270
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	130	94	NA	NA	NA	NA	NA	120
Beryllium	<2 0	<1 0	NA	NA	NA	NA	NA	<2.0
Calcium	93,000	41,000	NA	NA	NA	NA	NA	71,000
Cadmium	<5 0	<4 0	NA	NA	NA	NA	NA	<5 0
Cobalt	<29 0	<13 0	NA	NA	NA	NA	NA	<29 0
Chromium	12	23	NA	NA	NA	NA	NA	<9 0
Copper	10	33	NA	NA	NA	NA	NA	4 4
Iron	210	3,600	NA	NA	NA	NA	NA	310
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	12,000	5,800	NA	NA	NA	NA	NA	12,000
Manganese	17	57	NA	NA	NA	NA	NA	17
Molybdenum	<27 0	<24 0	NA	NA	NA	NA	NA	<27 0
Sodium	42,000	18,000	NA	NA	NA	NA	NA	59,000
Nickel	<22 0	36	NA	NA	NA	NA	NA	<22 0
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	<50 0	<55 0	NA	NA	NA	NA	NA	<50 0
Strontium	400	190	NA	NA	NA	NA	NA	440
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	<34 0	<15 0	NA	NA	NA	NA	NA	<34 0
Zinc	150	240	NA	NA	NA	NA	NA	360

Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID / Date Collected / Report Date / Lab Batch Number	BS 865-1 08-77	BS 865-1 05-78	BS 865-1 03-80	BS 865-1 06-80	BS 865-1 03-81	FD 865-1 04-12-88 05-12-88 88 ENV 02467	BS 865-1 07-26-88 11-30-88 88 ENV 02999	BS 865-1 10-04-88 12-06-88 88 ENV 03310
Gross Alpha (pCi/L)	23	27	29	23	79	11[±15]	10[±11]	15[±18]
Gross Beta (pCi/L)	NA	NA	22	38	29	3[±31]	6[±23]	-2[±23]
Tritium (pCi/L)	NA	NA	1,205	1,355	149	NA	NA	NA
Conductivity (µho/cm)	426	382	400	515	442	514	430	629
Total Dissolved Solids	282	246	242	329	197	292	267	366
pH (S U)	7 1	7 5	8 5	7 9	7 8	7 9	NA	8 6
Nitrate as N	2	4	2 6	5 3	1 2	1 1	8 39	5 95
Arsenic	NA	NA	NA	NA	NA	NA	<5	<5
Lead	NA	NA	NA	NA	NA	NA	22	13
Mercury	NA	NA	NA	NA	NA	NA	0 2	<0 2
Potassium	NA	NA	NA	NA	NA	NA	6,500	8,200
Selenium	NA	NA	NA	NA	NA	NA	<5	<5
Thallium	NA	NA	NA	NA	NA	NA	<10	<10
HSL METALS BY ICP								
Total or Dissolved	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Total	Total
Silver	NA	NA	NA	NA	NA	NA	NA	<7 6
Aluminum	NA	NA	NA	NA	NA	NA	NA	1,200
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	140
Beryllium	NA	NA	NA	NA	NA	NA	NA	<1 0
Calcium	NA	NA	NA	NA	NA	NA	NA	72,000
Cadmium	NA	NA	NA	NA	NA	NA	NA	7 4
Cobalt	NA	NA	NA	NA	NA	NA	NA	<22 0
Chromium	NA	NA	NA	NA	NA	NA	NA	15
Copper	NA	NA	NA	NA	NA	NA	NA	17
Iron	NA	NA	NA	NA	NA	NA	NA	1,300
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	14,000
Manganese	NA	NA	NA	NA	NA	NA	NA	24
Molybdenum	NA	NA	NA	NA	NA	NA	NA	<22 0
Sodium	NA	NA	NA	NA	NA	NA	NA	37,000
Nickel	NA	NA	NA	NA	NA	NA	NA	<37 0
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	<34 0
Strontium	NA	NA	NA	NA	NA	NA	NA	600
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	<36 0
Zinc	NA	NA	NA	NA	NA	NA	NA	430

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Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID	BS 865-1	BS 865-1	FD 865-1	BS 865-1	865 TRENCH	865 E DITCH	865 W DITCH	865 PIT
Date Collected	12-15-88	04-26-89	06-21-89	09-15-89	01-16-90	03-14-90	03-14-90	04-05-90
Report Date	2-15-89	07-27-89	08-25-89	11-22-89	01-30-90	03-19-90	03-19-90	04-16-90
Lab Batch Number	88 ENV 03608	89 ENV 00822	89 ENV 01162	89 ENV 01662	90 ENV 00069	90 ENV 00310	90 ENV 00310	90 ENV 00495
Gross Alpha (pCi/L)	−4[±10]	6[±14]	9[±11]	14[±12]	215[±60]	7[±10]	16[±14]	48[±22]
Gross Beta (pCi/L)	2[±16]	4[±21]	−2[±17]	4[±18]	305[±72]	20[±20]	12[±18]	82[±25]
Tritium (pCi/L)	NA	NA	NA	NA	NA	NA	NA	NA
Conductivity (µho/cm)	264	500	246	487	NA	NA	NA	NA
Total Dissolved Solids	190	404	181	314	NA	NA	NA	NA
pH (S U)	7.4	8.3	7.8	7.5	NA	7.7	7.6	NA
Nitrate as N	7.35	5.96	2.81	0.03	16	3.57	2.91	0.62
Arsenic	<5	<5	<10	2.6	NA	NA	NA	NA
Lead	<5	21	5	11.8	NA	NA	NA	NA
Mercury	<0.2	<0.2	<0.2	<0.2	NA	NA	NA	NA
Potassium	5,300	5,000	4,020	5,760	NA	NA	NA	NA
Selenium	<5	<5	<5	<1.0	NA	NA	NA	NA
Thallium	<10	<1	<10	<1.0	NA	NA	NA	NA
HSL METALS BY ICP								
Total or Dissolved	Total	Unknown	Unknown	Total	Unknown	Unknown	Unknown	Unknown
Silver	<7.6	<76	<4.0	<4.0	NA	NA	NA	NA
Aluminum	590	1,700	970	800	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	55	120	69	130	NA	NA	NA	NA
Beryllium	<1.0	<1.0	<2.0	<2.0	NA	NA	NA	NA
Calcium	29,000	60,000	30,000	72,000	NA	NA	NA	NA
Cadmium	<5.0	23	71	8.2	NA	NA	NA	NA
Cobalt	<22.0	<0.20	<29.0	<29.0	NA	NA	NA	NA
Chromium	18	<10.0	<9.0	<9.0	NA	NA	NA	NA
Copper	<6.3	28	7.1	18	NA	NA	NA	NA
Iron	600	2,100	860	4,100	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	5,800	11,000	5,800	12,000	NA	NA	NA	NA
Manganese	13	51	12	970	NA	NA	NA	NA
Molybdenum	<22.0	<22.0	<27.0	<27.0	NA	NA	NA	NA
Sodium	20,000	39,000	17,000	26,000	NA	NA	NA	NA
Nickel	<37.0	<37.0	<22.0	<22.0	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	<34.0	<34.0	<50.0	<50.0	NA	NA	NA	NA
Strontium	230	470	240	520	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	<36.0	<36.0	<34.0	<34.0	NA	NA	NA	NA
Zinc	37	300	28	190	NA	NA	NA	NA

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Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID	BS 865-1	BS 865-1	BS 865-1	FD 881-1	FD 881-1	FD 881-1	FD 881-1	FD 881-1
Date Collected	06-09-90	02-23-91	05-05-91	08-77	05-78	08-78	01-79	07-79
Report Date	08-27-90	05-22-91	05-28-91					
Lab Batch Number	90 ENV 01076	91 ENV 00302	91 ENV 00972					
Gross Alpha (pCi/L)	9[±2]	12[±3]	5[±1]	30	21	37	34	28
Gross Beta (pCi/L)	11[±2]	17[±4]	6[±1]	NA	NA	NA	NA	NA
Tritium (pCi/L)	NA	NA	NA	NA	NA	NA	NA	NA
Conductivity (µho/cm)	551	775	398	241	562	699	667	690
Total Dissolved Solids	331	524	242	476	359	465	434	430
pH (S U)	NA	NA	NA	7 2	8 1	7 6	7 6	7 3
Nitrate as N	5 33	10 7	3 62	7	8	10	9 0	7 7
Arsenic	1.1	2 2	NA	NA	NA	NA	NA	NA
Lead	21.8	12 5	NA	NA	NA	NA	NA	NA
Mercury	0.5	<2 2	NA	NA	NA	NA	NA	NA
Potassium	5,820	NA	NA	NA	NA	NA	NA	NA
Selenium	<0 2	4	NA	NA	NA	NA	NA	NA
Thallium	<1 0	<1	NA	NA	NA	NA	NA	NA
HSL METALS BY ICP								
Total or Dissolved	Unknown	Unknown	Total	Unknown	Unknown	Unknown	Unknown	Unknown
Silver	<3 0	<4 0	<6 0	NA	NA	NA	NA	NA
Aluminum	370	310	230	NA	NA	NA	NA	NA
Arsenic	NA	<103	<131	NA	NA	NA	NA	NA
Barium	130	200	85	NA	NA	NA	NA	NA
Beryllium	<1.0	<1 0	<1 0	NA	NA	NA	NA	NA
Calcium	56,000	94,000	44,000	NA	NA	NA	NA	NA
Cadmium	7	<4 0	3 1	NA	NA	NA	NA	NA
Cobalt	<10	<6 0	<4 0	NA	NA	NA	NA	NA
Chromium	<7 0	<6 0	<7 0	NA	NA	NA	NA	NA
Copper	12	25	<9 0	NA	NA	NA	NA	NA
Iron	1,000	520	220	NA	NA	NA	NA	NA
Lead	NA	<69 0	<73 0	NA	NA	NA	NA	NA
Magnesium	10,000	20,000	8,400	NA	NA	NA	NA	NA
Manganese	95	30	14	NA	NA	NA	NA	NA
Molybdenum	<17 0	<13 0	<9 0	NA	NA	NA	NA	NA
Sodium	35,000	24,000	26,000	NA	NA	NA	NA	NA
Nickel	<36 0	<14 0	<9 0	NA	NA	NA	NA	NA
Potassium	NA	11,000	3,200	NA	NA	NA	NA	NA
Selenium	NA	<52 0	<76 0	NA	NA	NA	NA	NA
Antimony	<45 0	<23 0	<34 0	NA	NA	NA	NA	NA
Strontium	420	880	340	NA	NA	NA	NA	NA
Thallium	NA	<139	<164	NA	NA	NA	NA	NA
Vanadium	<17 0	<8 0	<10 0	NA	NA	NA	NA	NA
Zinc	240	300	50	NA	NA	NA	NA	NA

Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID	FD 881-1	FD 881-1	FD 881-1	FD 881-1	FD 881-1	FD 881-1	FD 881-1	FD 881-1
Date Collected	03-80	06-80	09-80	03-81	09-81	04-12-88	07-26-88	10-10-88
Report Date						05-12-88	11-30-88	12-06-88
Lab Batch Number						88 ENV 02467	88 ENV 02999	88 ENV 03334
Gross Alpha (pCi/L)	6	22	13	15	17	10[±14]	20[±14]	15[±13]
Gross Beta (pCi/L)	38	26	4	41	10	5[±31]	8[±23]	4[±13]
Tritium (pCi/L)	1,401	1,150	963	1,253	623	NA	NA	NA
Conductivity (µho/cm)	606	715	606	169	561	764	747	864
Total Dissolved Solids	375	477	392	32	353	508	440	535
pH (S U)	8 3	7 7	7 6	6 5	8 1	8 3	NA	7 9
Nitrate as N	9 4	11 1	8 2	1	8 7	4 9	4 55	3 54
Arsenic	NA	NA	NA	NA	NA	NA	<5	<5
Lead	NA	NA	NA	NA	NA	NA	<5	<5
Mercury	NA	NA	NA	NA	NA	NA	<0 2	<0 2
Potassium	NA	NA	NA	NA	NA	NA	4,100	3,900
Selenium	NA	NA	NA	NA	NA	NA	<5	<5
Thallium	NA	NA	NA	NA	NA	NA	<10	<10
HSL METALS BY ICP								
Total or Dissolved	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Total	Total
Silver	NA	NA	NA	NA	NA	NA	NA	<7 6
Aluminum	NA	NA	NA	NA	NA	NA	NA	240
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	160
Beryllium	NA	NA	NA	NA	NA	NA	NA	<1 0
Calcium	NA	NA	NA	NA	NA	NA	NA	89,000
Cadmium	NA	NA	NA	NA	NA	NA	NA	<5 0
Cobalt	NA	NA	NA	NA	NA	NA	NA	<22 0
Chromium	NA	NA	NA	NA	NA	NA	NA	11
Copper	NA	NA	NA	NA	NA	NA	NA	<6 3
Iron	NA	NA	NA	NA	NA	NA	NA	180
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	20,000
Manganese	NA	NA	NA	NA	NA	NA	NA	12
Molybdenum	NA	NA	NA	NA	NA	NA	NA	<22 0
Sodium	NA	NA	NA	NA	NA	NA	NA	45,000
Nickel	NA	NA	NA	NA	NA	NA	NA	<37 0
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	<34 0
Strontium	NA	NA	NA	NA	NA	NA	NA	710
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	<36 0
Zinc	NA	NA	NA	NA	NA	NA	NA	85

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Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID Date Collected Report Date Lab Batch Number	FD 881–1 12–15–88 2–15–89 88 ENV 03608	FD 881–1 04–26–89 07–27–89 89 ENV 00822	FD 881–1 06–21–89 08–25–89 89 ENV 01162	FD 881–1 09–15–89 11–22–89 89 ENV 01662	FD 881–1 06–09–90 08–27–90 90 ENV 01076	FD 881–1 02–23–91 05–22–91 91 ENV 00296	FD 881–1 05–05–91 05–28–91 91 ENV 00972	BS 881–2 08–78
Gross Alpha (pCi/L)	10[±10]	12[±14]	15[±13]	21[±15]	8[±1]	2[±1]	8[±2]	7
Gross Beta (pCi/L)	16[±13]	4[±21]	25[±21]	8[±19]	8[±2]	7[±1]	5[±1]	NA
Tritium (pCi/L)	NA	NA	NA	NA	NA	NA	NA	NA
Conductivity (µho/cm)	663	693	773	646	677	422	743	202
Total Dissolved Solids	529	519	520	407	436	250	469	144
pH (S U)	8 2	8 0	8 2	8 6	NA	NA	NA	6 7
Nitrate as N	6 28	6 02	6 93	NA	5 56	1 65	5 73	3
Arsenic	<5	<5	<10	4 6	<1 0	2 5	NA	NA
Lead	<5	3	<3	2 2	6 4	1 6	NA	NA
Mercury	<0 2	<0 2	<0 2	<0 2	<0 2	<2	NA	NA
Potassium	3,500	1,400	4,200	3,990	3,740	NA	NA	NA
Selenium	<5	<5	4	3 7	4 1	2 6	NA	NA
Thallium	<5	<1	<10	<1 0	<1 0	<1	NA	NA
HSL METALS BY ICP								
Total or Dissolved	Total	Unknown	Unknown	Total	Unknown	Unknown	Total	Unknown
Silver	<7 6	<76	<4 0	<4 0	<3 0	<4 0	<6 0	NA
Aluminum	270	150	420	330	72	86	170	NA
Arsenic	NA	NA	NA	NA	NA	<103	<131	NA
Barium	140	130	200	180	110	82	130	NA
Beryllium	<1.0	<1.0	<2.0	<2 0	<1 0	<1 0	<1 0	NA
Calcium	89,000	83,000	130,000	85,000	61,000	41,000	82,000	NA
Cadmium	<5 0	<5 0	<5 0	<5 0	<5 0	<4 0	<3 0	NA
Cobalt	<22 0	<0 20	<29 0	<29 0	<10	<6 0	<4 0	NA
Chromium	10	<10 0	<9 0	<9 0	<7 0	<6 0	<7 0	NA
Copper	11	<6 3	4 2	4 2	<2 0	15	<9 0	NA
Iron	210	160	350	230	49	98	100	NA
Lead	NA	NA	NA	NA	NA	<69 0	<73.0	NA
Magnesium	20,000	20,000	22,000	19,000	18,000	9,000	17,000	NA
Manganese	13	<5 1	25	6 2	3 3	12	8 2	NA
Molybdenum	<22 0	<22 0	<27 0	<27 0	<17 0	<13 0	<9 0	NA
Sodium	41,000	48,000	50,000	42,000	41,000	24,000	40,000	NA
Nickel	<37 0	<37 0	<22 0	<22 0	<36 0	<14 0	<9 0	NA
Potassium	NA	NA	NA	NA	NA	5,800	3,200	NA
Selenium	NA	NA	NA	NA	NA	<52 0	<76 0	NA
Antimony	<34.0	35	<50.0	<50.0	<45 0	<23 0	<34 0	NA
Strontium	670	670	780	640	520	280	550	NA
Thallium	NA	NA	NA	NA	NA	<139	<164	NA
Vanadium	<36 0	<36 0	<34 0	<34 0	<17 0	<8 0	<10 0	NA
Zinc	34	210	200	84	23	110	45	NA

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Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID Date Collected Report Date Lab Batch Number	BS 881–3 08–77	BS 881–3 05–78	BS 881–3 08–78	BS 881–3 01–79	BS 881–3 03–80	BS 881–3 06–80	BS 881–3 09–80	BS 881–3 03–81
Gross Alpha (pCi/L)	9	16	21	48	–2	33	16	22
Gross Beta (pCi/L)	NA	NA	NA	NA	17	11	–6	12
Tritium (pCi/L)	NA	NA	NA	NA	1,442	1,388	1,109	474
Conductivity (µho/cm)	500	431	476	385	377	425	400	549
Total Dissolved Solids	329	268	314	233	238	277	248	209
pH (S U)	7 1	8 2	7 2	7 4	8 0	8 0	7 5	7 8
Nitrate as N	3	5	4	2 6	2 9	3 1	2 3	1
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
HSL METALS BY ICP								
Total or Dissolved	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Silver	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA
Strontium	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA

Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID	BS 881-3	BS 881-3	BS 881-3	BS 881-3	BS 881-3	BS 881-3	BS 881-3	BS 881-3
Date Collected	09-81	04-12-88	07-26-88	10-04-88	12-15-88	04-26-89	06-21-89	09-15-89
Report Date		05-12-88	11-30-88	12-06-88	2-15-89	07-27-89	08-25-89	11-22-89
Lab Batch Number		88 ENV 02467	88 ENV 02999	88 ENV 03310	88 ENV 03608	89 ENV 00822	89 ENV 01162	89 ENV 01662
Gross Alpha (pCi/L)	7	15[±16]	20[±14]	7[±18]	5[±11]	15[±19]	0[±9]	20[±15]
Gross Beta (pCi/L)	8	4[±31]	10[±23]	5[±25]	31[±20]	1[±19]	-4[±17]	6[±18]
Tritium (pCi/L)	328	NA	NA	NA	NA	NA	NA	NA
Conductivity (μho/cm)	177	705	603	559	610	517	600	566
Total Dissolved Solids	150	407	341	293	412	398	406	353
pH (S U)	6.7	7.9	NA	7.9	7.9	7.8	7.8	7.9
Nitrate as N	1.7	3.1	0.49	3.04	3.46	3.74	6.82	7.56
Arsenic	NA	NA	<5	<5	<5	<5	17	<1.0
Lead	NA	NA	<5	11	<5	4.2	4	4
Mercury	NA	NA	0.3	<0.2	<0.2	<0.2	0.2	<0.2
Potassium	NA	NA	3,800	5,500	4,800	2,200	5,110	4,850
Selenium	NA	NA	<5	<5	<5	<5	3	2.6
Thallium	NA	NA	<10	<10	<10	<1	<10	<1.0
HSL METALS BY ICP								
Total or Dissolved	Unknown	Unknown	Total	Total	Total	Unknown	Unknown	Total
Silver	NA	NA	NA	<7.6	<7.6	<7.6	<4.0	<4.0
Aluminum	NA	NA	NA	210	130	80	52	38
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	150	140	130	140	140
Beryllium	NA	NA	NA	<1.0	<1.0	<1.0	<2.0	<2.0
Calcium	NA	NA	NA	63,000	64,000	61,000	63,000	64,000
Cadmium	NA	NA	NA	<5.0	<5.0	<5.0	<5.0	<5.0
Cobalt	NA	NA	NA	<22.0	<22.0	<0.20	<29.0	<29.0
Chromium	NA	NA	NA	23	14	<10.0	<9.0	<9.0
Copper	NA	NA	NA	69	36	44	23	26
Iron	NA	NA	NA	310	310	280	57	69
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	16,000	18,000	14,000	15,000	15,000
Manganese	NA	NA	NA	13	5.6	8.8	4.7	5.1
Molybdenum	NA	NA	NA	<22.0	<22.0	<22.0	<27.0	<27.0
Sodium	NA	NA	NA	55,000	51,000	44,000	45,000	35,000
Nickel	NA	NA	NA	<37.0	<37.0	<37.0	<22.0	<22.0
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	<34.0	<34.0	36	<50.0	<50.0
Strontium	NA	NA	NA	610	610	53	510	500
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	<36.0	<36.0	<36.0	<34.0	<34.0
Zinc	NA	NA	NA	52	43	41	19	38

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Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID Date Collected Report Date Lab Batch Number	BS 881–3 12–17–89 04–07–90 E89–3097	BS 881–3 06–09–90 08–27–90 90 ENV 01076	SEEP N OF 881 05–25–90 06–11–90 90 ENV 00969	FD 883–1 08–77	FD 883–1 05–78	FD 883–1 07–79	FD 883–1 03–80	FD 883–1 06–80
Gross Alpha (pCi/L)	9[±8]	7[±1]	3[±1]	38	11	5	–5	24
Gross Beta (pCi/L)	8[±13]	10[±2]	17[±3]	NA	NA	NA	17	0
Tritium (pCi/L)	NA	NA	NA	NA	NA	NA	527	699
Conductivity (µho/cm)	623	630	NA	167	105	182	95	190
Total Dissolved Solids	393	371	NA	100	61	155	55	147
pH (S U)	7 9	NA	7 5	7 4	7 4	7 1	7 7	6 2
Nitrate as N	3 92	6 6	1 1	2	1	1	1 3	4 6
Arsenic	2 6	1 6	NA	NA	NA	NA	NA	NA
Lead	2 7	12 4	NA	NA	NA	NA	NA	NA
Mercury	<0 2	0 3	NA	NA	NA	NA	NA	NA
Potassium	5,650	5,620	NA	NA	NA	NA	NA	NA
Selenium	2 7	3 4	NA	NA	NA	NA	NA	NA
Thallium	<1 0	<1 0	NA	NA	NA	NA	NA	NA
HSL METALS BY ICP								
Total or Dissolved	Total	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Silver	<6 0	<3 0	NA	NA	NA	NA	NA	NA
Aluminum	210	68	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	160	150	NA	NA	NA	NA	NA	NA
Beryllium	<1.0	<1.0	NA	NA	NA	NA	NA	NA
Calcium	66,000	65,000	NA	NA	NA	NA	NA	NA
Cadmium	<4 0	<5 0	NA	NA	NA	NA	NA	NA
Cobalt	<13 0	<10	NA	NA	NA	NA	NA	NA
Chromium	<7 0	<7.0	NA	NA	NA	NA	NA	NA
Copper	31	26	NA	NA	NA	NA	NA	NA
Iron	190	100	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	18,000	16,000	NA	NA	NA	NA	NA	NA
Manganese	5 7	4 9	NA	NA	NA	NA	NA	NA
Molybdenum	<24.0	<17.0	NA	NA	NA	NA	NA	NA
Sodium	50,000	45,000	NA	NA	NA	NA	NA	NA
Nickel	45	<36 0	NA	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	<55 0	<45 0	NA	NA	NA	NA	NA	NA
Strontium	590	510	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	16	<17 0	NA	NA	NA	NA	NA	NA
Zinc	50	49	NA	NA	NA	NA	NA	NA

Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID Date Collected Report Date Lab Batch Number	FD 883-1 09-80	FD 883-1 03-81	FD 883-1 09-81	BS 883-1 04-12-88 05-12-88 88 ENV 02467	BS 883-1 07-26-88 11-30-88 88 ENV 02999	BS 883-1 10-04-88 12-06-88 88 ENV 03310	BS 883-1 09-15-89 11-22-89 89 ENV 01662	BS 883-1 12-17-89 04-07-90 E89-3097
Gross Alpha (pCi/L)	34	38	7	20[±16]	18[±13]	18[±20]	10[±14]	20[±14]
Gross Beta (pCi/L)	2	23	8	18[±29]	12[±25]	14[±22]	1[±17]	3[±16]
Tritium (pCi/L)	1,040	881	328	NA	NA	NA	NA	NA
Conductivity (µho/cm)	576	297	177	1,055	456	548	11,300	501
Total Dissolved Solids	408	122	150	664	290	314	854	322
pH (S U)	7.0	6.9	6.7	7.8	NA	8.7	7.7	7.8
Nitrate as N	13.2	2.9	1.7	4.4	0.98	2.37	7.4	2.48
Arsenic	NA	NA	NA	NA	<5	<5	6.8	1.8
Lead	NA	NA	NA	NA	6	17	3.2	33.7
Mercury	NA	NA	NA	NA	1.7	<0.2	<0.2	<0.2
Potassium	NA	NA	NA	NA	5,000	5,500	4,020	9,550
Selenium	NA	NA	NA	NA	<5	<5	1.1	7.3
Thallium	NA	NA	NA	NA	<10	<10	<1.0	<1.0
HSL METALS BY ICP								
Total or Dissolved	Unknown	Unknown	Unknown	Unknown	Total	Total	Total	Total
Silver	NA	NA	NA	NA	NA	<7.6	<4.0	<6.0
Aluminum	NA	NA	NA	NA	NA	1,300	1,300	2,700
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	120	230	140
Beryllium	NA	NA	NA	NA	NA	<1.0	<2.0	<1.0
Calcium	NA	NA	NA	NA	NA	63,000	140,000	50,000
Cadmium	NA	NA	NA	NA	NA	<5.0	<5.0	9.1
Cobalt	NA	NA	NA	NA	NA	<22.0	<29.0	<13.0
Chromium	NA	NA	NA	NA	NA	18	<9.0	16
Copper	NA	NA	NA	NA	NA	16	8.9	29
Iron	NA	NA	NA	NA	NA	1,400	1,000	2,800
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	18,000	27,000	14,000
Manganese	NA	NA	NA	NA	NA	180	26	180
Molybdenum	NA	NA	NA	NA	NA	<22.0	<27.0	<24.0
Sodium	NA	NA	NA	NA	NA	44,000	63,000	53,000
Nickel	NA	NA	NA	NA	NA	<37.0	<22.0	<36.0
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	<34.0	<50.0	<55.0
Strontium	NA	NA	NA	NA	NA	630	1,000	480
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	<36.0	<34.0	<15.0
Zinc	NA	NA	NA	NA	NA	820	93	1,300

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Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID	BS 883-1	SEEP N OF 88	BS 887-1	BS 887-1	FD 991-1	FD 991-1	FD 991-1	FD 991-1
Date Collected	05-05-91	05-25-90	07-79	03-80	05-78	03-80	06-80	09-80
Report Date	05-28-91	06-11-90						
Lab Batch Number	91 ENV 00972	90 ENV 00969						
Gross Alpha (pCi/L)	5[±1]	3[±1]	674	220	14	24	15	16
Gross Beta (pCi/L)	8[±1]	17[±3]	NA	324	NA	-2	37	16
Tritium (pCi/L)	NA	NA	NA	NA	NA	550	562	872
Conductivity (µho/cm)	519	NA	182	2,600	455	770	235	147
Total Dissolved Solids	304	NA	1,339	1,951	293	492	136	98
pH (S U)	NA	7 5	8 1	9 4	7 4	7 6	6 9	6 3
Nitrate as N	2 94	1 1	4 7	2 5	1	1	1 2	2 3
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
HSL METALS BY ICP								
Total or Dissolved	Total	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Silver	<6 0	NA	NA	NA	NA	NA	NA	NA
Aluminum	520	NA	NA	NA	NA	NA	NA	NA
Arsenic	<131	NA	NA	NA	NA	NA	NA	NA
Barium	94	NA	NA	NA	NA	NA	NA	NA
Beryllium	<1 0	NA	NA	NA	NA	NA	NA	NA
Calcium	55,000	NA	NA	NA	NA	NA	NA	NA
Cadmium	3 7	NA	NA	NA	NA	NA	NA	NA
Cobalt	<4 0	NA	NA	NA	NA	NA	NA	NA
Chromium	<7 0	NA	NA	NA	NA	NA	NA	NA
Copper	11	NA	NA	NA	NA	NA	NA	NA
Iron	370	NA	NA	NA	NA	NA	NA	NA
Lead	<73 0	NA	NA	NA	NA	NA	NA	NA
Magnesium	12,000	NA	NA	NA	NA	NA	NA	NA
Manganese	31	NA	NA	NA	NA	NA	NA	NA
Molybdenum	<9 0	NA	NA	NA	NA	NA	NA	NA
Sodium	32,000	NA	NA	NA	NA	NA	NA	NA
Nickel	<9 0	NA	NA	NA	NA	NA	NA	NA
Potassium	4,200	NA	NA	NA	NA	NA	NA	NA
Selenium	<76 0	NA	NA	NA	NA	NA	NA	NA
Antimony	<34 0	NA	NA	NA	NA	NA	NA	NA
Strontium	420	NA	NA	NA	NA	NA	NA	NA
Thallium	<164	NA	NA	NA	NA	NA	NA	NA
Vanadium	<10 0	NA	NA	NA	NA	NA	NA	NA
Zinc	200	NA	NA	NA	NA	NA	NA	NA

Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID	991 DRAINS	995 EFF	995 EFF
Date Collected	05-02-89	05-02-89	05-12-89
Report Date	05-12-89		
Lab Batch Number	89 ENV 00860	E89-0855	E89-0915
Gross Alpha (pCi/L)	20 (±15)	NA	NA
Gross Beta (pCi/L)	36 (±25)	NA	NA
Tritium (pCi/L)	NA	NA	NA
Conductivity (μmho/cm)	NA	NA	NA
Total Dissolved Solids	NA	NA	NA
pH (S U)	NA	NA	NA
Nitrate as N	0 86	NA	NA
Arsenic	NA	NA	NA
Lead	NA	NA	NA
Mercury	NA	NA	NA
Potassium	NA	NA	NA
Selenium	NA	NA	NA
Thallium	NA	NA	NA
HSL METALS BY ICP			
Total or Dissolved	Unknown	Unknown	Unknown
Silver	<76	<76	<76
Aluminum	3,130	160	300
Arsenic	NA	NA	NA
Barium	570	20	11
Beryllium	2.1	<1 0	<1 0
Calcium	96,000	NA	NA
Cadmium	32 1	9 5	<5 0
Cobalt	<0 20	<0 20	<0 20
Chromium	15	18	<10 0
Copper	23	<6 3	<6 3
Iron	15,000	160	150
Lead	NA	NA	NA
Magnesium	13,000	NA	NA
Manganese	830	31	22
Molybdenum	<22 0	<22 0	<22 0
Sodium	20,000	NA	NA
Nickel	100	58	<37 0
Potassium	NA	NA	NA
Selenium	NA	NA	NA
Antimony	<34 0	<34 0	<34 0
Strontium	410	170	130
Thallium	NA	NA	NA
Vanadium	<36 0	<36 0	<36 0
Zinc	970	72	51

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Table 5 – Foundation Drain and Building Sump Analytical Results
1977 – 1991
RADIONUCLIDES AND METALS

Sample ID Date Collected Report Date Lab Batch Number	Background 99/99 UTL Groundwater Upper HSU	Background 99/99 UTL Stream Water (Sitewide)	Background 99/99 UTL Seeps/Springs
Gross Alpha (pCi/L)	390 58	28 06	340 13
Gross Beta (pCi/L)	221 31	30 35	9 74
Tritium (pCi/L)	13,539 22	711 94	4,277 76
Conductivity (µho/cm)	n/r	n/r	n/r
Total Dissolved Solids	1,082,479 41	302,280 65	813,806 81
pH (S U)	– –	9 32	8 64
Nitrate as N	n/r	n/r	n/r
Arsenic	5 93	5 84	675 73
Lead	11 75	7 36	745 05
Mercury	0 22	n/r	n/r
Potassium	4,472 65	4,167 09	13,071 50
Selenium	47 99	6 33	15 64
Thallium	5 77	n/r	n/r
HSL METALS BY ICP			
Total or Dissolved	Total	Total	Total
Silver	n/r	n/r	97 35
Aluminum	12,642 33	3,892 76	166,871 02
Arsenic	5 93	5 84	675 73
Barium	208 14	138 11	6,252 00
Beryllium	n/r	n/r	13 86
Calcium	128,816 15	49,464 66	500,177 15
Cadmium	n/r	n/r	67 29
Cobalt	n/r	n/r	346 73
Chromium	22 58	n/r	183 74
Copper	39 12	16 95	359 20
Iron	14,654 53	7,926 75	1,811,483 71
Lead	11 75	7 36	745 05
Magnesium	28,854 11	9,812 65	34,488 56
Manganese	331 64	885 29	17,658 34
Molybdenum	116 04	n/r	165 51
Sodium	123,327 78	33,817 24	27,834 09
Nickel	32 68	n/r	438 78
Potassium	4,472 65	4,167 09	13,017 50
Selenium	47 99	6 33	15 64
Antimony	49 14	n/r	411 91
Strontium	994 25	590 13	2,009 06
Thallium	5 77	n/r	n/r
Vanadium	46 64	28 76	1,002 88
Zinc	153.21	175 64	1,556 36

Legend

Concentrations in micrograms per liter unless otherwise noted

< = Not detected, the associated value is the sample quantification limit

(1) Analysis run twice Most conservative value shown
HSL = Hazardous Substance List
HSU = hydrostratigraphic unit
ICP = Inductively Coupled Plasmometry
NA = Not analyzed
n/r = Not Reported
pCi/L = picoCuries per liter
s u = standard units
UTL = Upper Tolerance Limit
µmho/cm = micromhos per centimeter
– – = As a result of small sample set, erroneous value reported (18 2)

= Exceeds 99/99 UTL for stream water (sitewide)

= Exceeds 99/99 UTL for background groundwater, upper hydrostratigraphic unit and stream water (sitewide)

= Exceeds 99/99 UTL for background groundwater, upper hydrostratigraphic unit

Table 6 – Foundation Drain and Building Sump Analytical Results
1992 – 1993
Metals

Sample ID Date Collected	BS-111-2 04-26-93	BS-707-2 03-07-92	BS-707-2 03-27-93	BS-865-1 03-07-92	BS-865-1 03-27-93	BS-865-2 03-27-93	BS-883-1 03-07-92	FD-111-1 03-07-92	FD-371-3 03-07-92	FD-371-3 03-27-93	FD-371COMP 03-07-92	FD-371MC 03-27-93
ALUMINUM	453	123 B	68 B	176 B	232	564	1,790	139 B	122 B	86 B	175 B	97 B
ANTIMONY	<24	<25	<24	<25	<24	<24	<25	<25	<25	<24	<25	<24
ARSENIC	<1	19	18	<1	<1	<1	1 B	2 B	1 B	<1	<1	20
BARIUM	56 B	8 B	8 B	115 B	100 B	125 B	57 B	87 B	116 B	204	111 B	67 B
BERYLLIUM	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CADMIUM	<3	<4	<3	<4	4 B	<3	<4	<4	<4	<3	<4	<3
CALCIUM	23,800	16,300	15,900	55,200	52,500	59,000	23,400	46 500	59 300	167,000	59,000	24,300
CHROMIUM	30	10	6 B	<7	<5	<5	10 B	<7	<7	<5	<7	<5
COBALT	15 B	<7	<5	<7	<5	<5	<7	<7	<7	<5	<7	<5
COPPER	49	18 B	19 B	6 B	12 B	12 B	7 B	<4	7 B	6 B	<4	4 B
IRON	3,290	168	77 B	125	314	835	1,450	632	441	3,110	195	37 B
LEAD	3	2 B	2 B	2 B	3	36	1 B	1 B	7	<1	7	2 B
MAGNESIUM	3,830 B	2,530 B	2,520 B	10 000	9,240	29,500	6,740	7,440	11,000	22,900	10,700	1,900 B
MANGANESE	18	3 B	4 B	21	8 B	93	56	125	230	957	163	35
MERCURY	<0 2	<0 2	<0 2	<0 2	<0 2	<0 2	0	0	0	<0 2	0	<0 2
MOLYBDENUM	<10	<12	<10	<12	<10	<10	<12	<12	<12	<10	<12	16 B
NICKEL	<13	<19	<13	<19	<13	<13	<19	<19	<19	<13	<19	<13
POTASSIUM	39,000	49,300	61,000	4 230 B	5,900	2,100 B	4,220 B	2 710 B	4,690 B	6,880	3,310 B	4,330 B
SELENIUM	5 B	<1	<3	2 B	<3	<3	2 B	<1	1 B	<3	1 B	<3
SILVER	320	<5	<5	<5	<5	<0 2	<5	<5	<5	<5	<5	<5
SODIUM	19,500	70,100	79 500	31,400	40,500	54,800	19 300	28,500	26,900	29,500	27,000	13,000
STRONTIUM	143 B	78 B	79 B	414	385	789	214	229	365	1,040	338	121 B
THALLIUM	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
VANADIUM	<7	<11	<7	<11	<7	<7	<11	<11	<11	<7	<11	<7
ZINC	108	42	30	31	35	77	257	45	39	9 B	44	26

TABLE 6 – Foundation Drain and Building Sump Analytical Results
1992 – 1993
Metals

Sample ID / Date Collected	FD-444-460 03-07-92	FD-444-460 03-27-93	FD-559-561 07-25-92	FD-707-1 03-07-92	FD-771-1 05-01-93	FD-774-1 03-27-93	FD-883-1 05-01-93	FD-886-1 05-01-93	FD-886-2 05-01-93	FD-910 05-01-93	FD-991-1 04-26-93	99/99 UTL Groundwater	99/99 UTL Stream Water
ALUMINUM	166 B	1,710	72 B	290	619	2,580	202	100 B	60 B	88 B	99 B	12,642	3,893
ANTIMONY	<25	24	<21	<25	<24	<24	<24	<24	<24	<24	<24	49	n/r
ARSENIC	<1	<1	<1	2 B	<1	2 B	<1	<1	<1	2 B	<1	6	6
BARIUM	139 B	190 B	113 B	127 B	147 B	91 B	169 B	95 B	112 B	72 B	122 B	208	138
BERYLLIUM	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	n/r	n/r
CADMIUM	<4	<3	<5	<4	<3	<3	<2	<3	<3	<3	<3	n/r	n/r
CALCIUM	85,900	88,200	89,500	67,800	76,100	53,100	115,000	52 400	56,100	60,900	82,300	128 818	49,465
CHROMIUM	8 B	7 B	<5	<7	5 B	<5	<5	<5	<5	<5	<5	23	n/r
COBALT	<7	<5	<3	<7	<5	<5	<5	<5	<5	<5	<5	n/r	n/r
COPPER	7 B	63	<5	5 B	3 B	12 B	<2	<2	<2	<2	17 B	39	17
IRON	113	918	32 B	812	498	1 840	110	119	25 B	39 B	138	14,655	7,927
LEAD	2 B	7	5	1 B	<1	6	2 B	2 B	<1	3 B	3	12	7
MAGNESIUM	11,500	12,400	12,500	14,400	14,000	9 540	27,000	19 900	18,000	15 000	24,100	28 854	9 813
MANGANESE	6 B	41	3 B	301	11 B	40	4 B	2 B	<1	7 B	2 B	312	885
MERCURY	<0 2	<0 2	1	0	<0 2	<0 2	<0 2	<0 2	<0 2	<0 2	<0 2	0	n/r
MOLYBDENUM	<12	<10	<13	<12	<10	<10	<10	<10	<10	<10	<10	116	n/r
NICKEL	<19	<13	<24	<19	<13	<13	<13	<13	<13	<13	<13	33	n/r
POTASSIUM	2,250 B	1,390 B	<966	4,340 B	14,300	10,500	2,160 B	3,930 B	4,080 B	2,070 B	8,180	4,473	4,167
SELENIUM	<1	<3	<1	1 B	2 B	<3	2 B	5 B	4 B	2 B	5 B	48	6
SILVER	<5	5	<2	<5	<5	<5	<5	<5	<5	<5	<5	n/r	n/r
SODIUM	16,000	15,200	21,300	57,400	27 400	37,500	58,400	50,700	41,400	37,000	89,800	123,328	33 817
STRONTIUM	383	410	405	468	423	274	879	554	524	472	747	994	590
THALLIUM	<1	<1	<1	<1	<1	2 B	<1	<1	<1	<1	<1	6	n/r
VANADIUM	<11	<7	<8	<11	<7	<7	<7	<7	<7	<7	7 B	47	29
ZINC	166	<399	22	233	88	154	61	93	72	12 B	41	153	176

NOTES All results reported in micrograms per liter ($\mu g/L$)
< = Not detected, value shown is instrument detection limit
n/r = not reported
B = Result is less than method detection limit, but greater than instrument detection limit
None of the data were validated
UTL = Upper tolerance limit
Groundwater UTL is given for background groundwater from the upper hydrostratigraphic unit
= Exceeds background groundwater 99/99 UTL and stream water 99/99 UTL
= Exceeds background stream water 99/99 UTL
= Exceeds background groundwater 99/99 UTL

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samples collected in 1992-1993, although the highest concentration (2580 μg/L at FD-774-1, March 1993) did not exceed background surface water or groundwater UTLs Aluminum can be derived from corrugated pipe or other anthropogenic materials

Antimony was detected in six of 78 samples collected from 1988 to 1991, at concentrations ranging from 34 to 45 μg/L The background groundwater UTL was not exceeded, and a UTL for background surface water was not available for comparison. Antimony was detected in one sample (BS-444/460) at the detection limit (24 μg/L) in 1993

Arsenic was detected in 33 of 87 samples analyzed by furnace (AA) and in none of the 11 samples analyzed by ICP from 1988 to 1991 Arsenic values ranged from 1 to 1400 μg/L Arsenic concentrations exceeded the UTLs for background surface water (5 84 μg/L) and groundwater (5 93 μg/L) at FD-371-Comp (1,200 μg/L, December 1989; 1,400 μg/L, June 1990), at FD-371-3 (12 5 μg/L, December 1988; 37.8 μg/L, September 1989; 19 μg/L, December 1989, 1,400 μg/L, June 1990), at FD-707-1 (6 μg/L, December 1988, 6 3 μg/L, June 1990), at BS-707-2 (43 μg/L, July 1988; 26 μg/L, June 1989; 26 7 μg/L, September 1989; 222 μg/L, December 1989, 97 2 μg/L, June 1990; 19 μg/L, June 1991), at BS-881-3 (17 μg/L, June 1989), and at BS-883-1 (6 8 μg/L, September 1989) Results from 1992 to 1993 indicate that arsenic was detected in nine of 23 samples, at values ranging from 1.3 to 19 7 μg/L Background surface water and groundwater UTLs were exceeded at BS-707-2 (18.9 μg/L, March 1992, 17.6 μg/L, March 1993) and at FD-371MC (19.7 μg/L, March 1993).

Beryllium was detected in three of 78 samples from 1988 to 1991 and in none of the samples collected from 1992 to 1993. Low concentrations of beryllium were detected at FD-444-460 (2.5 μg/L, May 1991), FD-774-1 (2.4 μg/L, April 1989), and 991-Drains (2.1 μg/L, May 1989) No UTLs for groundwater or stream water were available in the *Background Geochemical Characterization Report* (EG&G 1993a) for comparison

Cadmium concentrations were also generally low The metal was detected in 13 of 78 samples collected from 1988 to 1991 at concentrations ranging from 3 1 to 32.1 μg/L. Cadmium was detected in one of 23 samples collected from 1992 to 1993, at 3.8 μg/L (BS-865-1, March 1993) No UTLs for groundwater or stream water were available in the *Background Geochemical Characterization Report* (EG&G 1993a) for comparison

Chromium was detected at concentrations ranging from 8.3 to 13,000 μg/L in 28 of 80 samples collected from 1988 to 1991 Chromium concentrations exceeded UTLs for background groundwater (22.58 μg/L) at FD-371-3 (33 μg/L, December 1988), at FD-444-460 (130 μg/L, April 1989), at FD-444 (13,000 μg/L, April 1989), at FD-516-1 (35 μg/L, October 1988; 24 μg/L, December 1988), at FD-774-1 (54 μg/L, April 1989, 23 μg/L, December 1989), and at BS-881-3 (23 μg/L, October 4 1988) Chromium was detected in seven of 23 samples collected from 1992 to 1993, at concentrations ranging from 5.1 to 29.7 μg/L. Samples exceeded background groundwater UTLs only at BS-111-2 (29.7 μg/L, April 1993). Background stream water UTLs were not available for comparison.

Cobalt was not detected in any of the 78 samples collected from 1988 to 1991, but was found at 14 7 μg/L in BS-111-2 from 1993 sampling Cobalt was also detected in the laboratory blank sample, however. The *Background Geochemical Characterization Report* (EG&G 1993a) did not report UTLs for cobalt in background stream water or groundwater.

Copper was detected in 58 of 78 samples collected from 1977 through 1991, in concentrations ranging from 4.2 to 360 μg/L. Background stream water (16.95 μg/L) and groundwater (39.12 μg/L) UTLs were exceeded at FD-444-460 (81 μg/L, April 1989; 130 μg/L, June 1989; 47 μg/L, September 1989, 190 μg/L, April 1990), FD-516-1 (58 μg/L, April 1989), FD-707-2 (110 μg/L, June 1989; 99 μg/L, December 1989; 70 μg/L, June 1990), FD-774-1 (360 μg/L, April 1989), and BS-881-3 (69 μg/L, October 1988; 44 μg/L, April 1989). The background stream water UTL was also exceeded at FD-111-1 (31 μg/L, June 1989), at FD-371-Composite (31 μg/L, December 1989), at FD-371-3 (20 μg/L, December 1989), at FD-516-1 (32 μg/L, October 1988, 18 μg/L, December 1989), at FD-707-1 (19 μg/L, December 1989), at BS-707-2 (27 μg/L, September 1989), at FD-774-1 (33 μg/L, December 1989), at FD-865-1 (17 μg/L, October 1988, 26 μg/L, April 1989; 18 μg/L, September 1989, 25 μg/L, February 1991), at BS-881-3 (36 μg/L, December 1988, 23 μg/L, June 1989; 26 μg/L, September 1989; 31 μg/L, December 1989, 26 μg/L, June 1990), BS-883-1 (29 μg/L, December 1989) and at 991 Drains (23 μg/L, May 1989)

Copper was detected in 16 of 23 samples from 1992 to 1993, at concentrations up to 63 3 μg/L Background groundwater and stream water UTLs were exceeded at BS-111-2 (48 7 μg/L, April 1993) and at FD-444-460 (63.3 μg/L, March 1993) Background stream water UTLs were also exceeded at BS-707-2 (18 3 μg/L, March 1992; 19.4 μg/L, March 1993).

Iron has been ubiquitous in building sump and foundation drain waters It was detected in every one of the 78 samples analyzed from 1988 to 1991, at concentrations ranging from 49 to 740,000 μg/L. Iron concentrations exceeded UTLs for background stream water (7,927 μg/L) and groundwater (14,655 μg/L) at FD-371-3 (64,000 μg/L, December 1988, 740,000 μg/L, September 1989; 95,000 μg/L, December 1989), at FD-516-1 (15,000 μg/L, October 1988, 24,000 μg/L, April 1989), and at FD-774-1 (20,000 μg/L, April 1989) and at 991 Drains (15,000 μg/L, May 1989). The element was also detected in every sample analyzed from 1992 to 1993. Iron concentrations in foundation drain and building sump samples ranged from 25.4 to 3290 μg/L, and did not exceed background UTLs.

Lead was not detected in any of the 11 samples analyzed by ICP from 1989 to 1991, but was detected in 65 of the 88 samples analyzed by furnace (AA) from that period. Concentrations ranged from 1.6 to 363 μg/L The background stream water (7.36 μg/L) and groundwater

(11.75 μg/L) UTLs were exceeded at FD-111-1 (13 μg/L, April 1989), at FD-371-3 (16 μg/L, October 1988), at FD-371-3 (110 μg/L, June 1989,), at BS-444 (278 μg/L, January 1991), at FD-444-460 (19 μg/L, April 1989; 20 μg/L, December 1989), at FD-516-1 (62 μg/L, October 1988; 48 μg/L, April 1989; 15 μg/L, June 1989), at FD-707-2 (15 μg/L, July 1988; 63 μg/L, June 1989, 17 2 μg/L, June 1990), FD-774-1 (363 μg/L, April 1989; 33.2 μg/L, December 1989), at BS-865-1 (22 μg/L, July 1988; 13 μg/L, October 1988, 21 μg/L, April 1989, 11.8 μg/L, September 1989; 21.8 μg/L, June 1990, 12.5 μg/L, February 1991), BS-881-3 (12.4 μg/L, June 1990), and BS-883-1 (17 μg/L, October 1988; 33 7 μg/L, December 1989). The background stream water UTL for lead was also exceeded at FD-371-Composite (8.1 μg/L, April 1989), at FD-371-3 (11 3 μg/L, September 1989), at FD-444-460 (8 μg/L, June 1989, 9 1 μg/L, September 1989), at FD-516-1 (10.4 μg/L, December 1989), at BS-707-3 (10 μg/L, July 1988; 9 3 μg/L, April 1989; 10.2 μg/L, September 1989), at FD-774-1 (11 μg/L, June 1989, 9 μg/L, September 1989), and at BS-883-1 (11 μg/L, October 1988). Lead was also detected in 20 of 23 samples from 1992 to 1993, with the highest concentration (36 μg/L) at BS-865-2 (March 1993). Other samples collected during this period contained less than 7 μg/L lead.

Manganese was detected in all but two of the samples analyzed during the 1977 to 1991 period Concentrations ranged from 3 3 to 14,000 μg/L. Manganese concentrations exceeded the UTLs for background stream water (885 μg/L) and groundwater (332 μg/L) at FD-371-Composite (1,100 μg/L, December 1990), FD-371-3 (14,000 μg/L, December 1988, 3,200 μg/L, September 1989; 3,200 μg/L, December 1989), at FD-701-1 (1,000 μg/L, April 1989), BS-865-1 (970 μg/L, September 1989), and 991 Drains (630 μg/L, May 1989). Background groundwater UTLs were also exceeded at FD-111-1 (430 μg/L, June 1989), at FD-371-Composite (340 μg/L, December 1988; 650 μg/L, June 1991), at FD-371-2 (370 μg/L, June 1991), and at FD-707-1 (740 μg/L, December 1988; 500 μg/L, December 1989; 480 μg/L, June 1990). Manganese was also detected in all of the building sump and foundation drain samples collected from 1992 to 1993 The highest concentrations were again detected at station FD-371-3 (957 μg/L, March 1993) and FD-707-1 (301 μg/L, March 1992).

Molybdenum was detected in only three of the 78 samples from 1988 to 1991, at concentrations ranging from 22 to 66 μg/L. The UTL for background groundwater (116.04 μg/L) was not exceeded. One of 23 samples collected from 1992 to 1993 contained detectable quantities of molybdenum Sample FD-371-MC (March 1993) contained 15.5 μg/L, but the element was also detected in the laboratory blank sample

Nickel was detected in six of 78 samples, at concentrations ranging from 36 to 100 μg/L. The background groundwater UTL (33 μg/L) was exceeded at FD-444-460 (36 μg/L, December 1990), at FD-707-1 (36 μg/L, December 1990), at FD-774-1 (71 μg/L, April 1989; 36 μg/L, December 1990), at BS-881-3 (45 μg/L, December 1989), and 991 Drains (100 μg/L, May 1989) Nickel was not detected during the 1992 to 1993 sampling.

Selenium was not detected in any of the 11 samples analyzed by ICP from 1989 to 1991, but was detected in 17 of the 87 samples analyzed by furnace (AA) during that period. All results were well below the UTL for background groundwater (47.99 μg/L). The background stream water UTL (6.33 μg/L) was exceeded only at BS-883-1 (7.3 μg/L, December 1989). Selenium was detected in 12 of 23 samples from 1992 to 1993, at concentrations ranging from 1 μg/L to 4.7 μg/L.

Silver was not detected in any of the 77 foundation drain and building sump samples analyzed during the 1988 to 1991 period (Table 5). Silver was detected in water from two samples (BS-111-2, 320 μg/L and FD-444-460, 5 μg/L) of 23 analyzed during 1992 and 1993 (Table 6). The *Background Geochemical Characterization Report* (EG&G 1993a) did not report UTLs for silver in background stream water or groundwater.

Thallium was detected in one of 87 samples collected from 1988 to 1991 and analyzed by furnace (AA) Sample BS-707-2 (December 1989) contained 1.1 μg/L, well below the background groundwater UTL (5 77 μg/L). None of the 11 samples analyzed from 1988 to 1991 by ICP contained detectable concentrations of thallium One of 23 samples collected from 1992 to 1993 contained detectable thallium. Sample FD-774-1 contained 2 μg/L, but the metal was also detected in the laboratory blank.

Zinc was detected in every sample for which it was analyzed from 1988 to 1993 Zinc concentrations ranged from 11 to 7,300 μg/L. The background stream water (176 μg/L) and groundwater (153 μg/L) UTLs were exceeded at FD-111-1 (340 μg/L, April 1989), at FD-371-3 (220 μg/L, June 1989), at FD-444-460 (1,700 μg/L, April 1989, 600 μg/L, June 1989, 480 μg/L, September 1989, 1,100 μg/L, December 1989; 370 μg/L, May 1991), at FD-516-1 (1,400 μg/L, October 1988, 1,900 μg/L, April 1989; 200 μg/L, June 1989, 180 μg/L, December 1989), at FD-707-1 (240 μg/L, April 1989; 200 μg/L, June 1990), at BS-707-2 (1,500 μg/L, June 1989; 250 μg/L, June 1990), at FD-707-3 (310 μg/L, October 1988, 330 μg/L, April 1989), at FD-774-1 (7300 μg/L, April 1989, 180 μg/L, June 1989; 240 μg/L, December 1989), at FD-779-1 (360 μg/L, September 1989), at BS-865-1 (430 μg/L, October 1988, 300 μg/L, April 1989, 190 μg/L, September 1989; 240 μg/L, June 1990; 300 μg/L, February 1991), at FD-881-1 (210 μg/L, April 1989, 200 μg/L, June 1989) at BS-883-1 (820 μg/L, October 1988, 1,300 μg/L, December 1989; 200 μg/L, May 1991), and at the 991 Drains (970 μg/L, May 1989) Background groundwater UTLs were also exceeded at FD-371-3 (170 μg/L, September 1989), and at FD-444-460 (160 μg/L, June 1990). Two samples collected from 1992 to 1993 exceeded background stream water and groundwater UTLs for zinc: BS-883-1 (257 μg/L, March 1992) and FD-701-1 (233 μg/L, March 1992). One sample collected during 1992 and 1993 slightly exceeded the groundwater UTL for zinc: FD-774-1 (154 μg/L, March 1993).

Foundation drain and building sump samples commonly exceeded background UTLs for calcium (approximately 75 percent were above), sodium (approximately 60 percent were above), potassium, and magnesium (approximately 75 percent were above), as indicated in Tables 5 and 6

4.2.2 Radionuclides

Screening analyses for radionuclides have been performed on building sump and foundation drain samples since at least 1977 Gross alpha counts ranged from -8 to 7,900 picocuries per liter (Pci/L) in the 234 building sump, foundation drain, and trench samples collected and analyzed for radionuclides from 1988 to 1991 (Table 5) Gross beta values ranged from -19 to 760 ±40 pCi/L in 174 samples and tritium counts ranged from -99 to 4,681 pCi/L in 57 samples collected during that period

Samples collected during 1992 and 1993 yielded gross alpha counts ranging from 0 20 ±0.6 to 6 ±2 pCi/L and gross beta from 1 50 ±1 5 to 61 ±4 pCi/L. Samples apparently were not analyzed for tritium during this period. The results are summarized in Table 7 and Figure 21

The background groundwater UTL for gross alpha (391 pCi/L) was exceeded at BS-707-3 (7,900 pCi/L, September 1981) and at BS-887-1 (674 pCi/L, July 1979). The UTL for gross alpha counts in background stream water (28 pCi/L) was exceeded in 56 of 234 samples collected from 1977 to 1991 (Table 5). Samples collected during 1992 and 1993 did not exceed the groundwater and stream water UTLs for gross alpha. Gross beta counts exceeded background stream water UTL at BS-111-2 (32 pCi/L, April 1993) and at BS-707-2 (45 pCi/L, March 1992; 61 pCi/L, March 1993). The background groundwater UTL for gross beta was not exceeded in foundation drain and building sump samples collected during 1992 and 1993.

Table 7 – Foundation Drain and Building Sump Analytical Results 1992 – 1993

Radionuclides

LOCATION	BS-111-2	BS-707-2	BS-707-2	BS-865-1	BS-865-1	BS-865-2	BS-883-1	FD-111-1	FD-371-3
DATE	04-26-93	03-07-92	03-27-93	03-07-92	03-27-93	03-27-93	03-07-92	03-07-92	03-07-92
GROSS ALPHA (pCi/L)	0 50	4 00	5 00	4 00	6 00	12 00	6 00	1 00	7 00
ERROR	1 2	1	2	1	2	2	1	1	2
GROSS BETA (pCi/L)	32.00	45.00	61.00	6 00	8 00	9 00	8 00	4 00	6 00
ERROR	4	3	4	1	2	2	1	1	2

LOCATION	FD-371-3	FD-371-3	FD-371-3	FD-371-3	FD-371-3	FD-371-3	FD-371-3	FD-371-3	FD-371-3
DATE	06-05-92	06-06-92	06-07-92	06-08-92	06-09-92	06-17-92	06-24-92	07-01-92	07-08-92
GROSS ALPHA (pCi/L)	4 90	4 40	4 70	3 10	1 30	1 70	0 58	1 40	1 20
ERROR	3	2 9	3 1	2 9	2 6	2 7	2 5	2 6	2 7
QUALIFIER	X	X	X	UX	U9	U	U	U	U
DETECTION LIMIT	3	3	4	4	4	4	4		4
GROSS BETA (pCi/L)	1 50	4 00	4 80	2 50	5 40	3 80	6 10	4 70	6 60
ERROR	1 5	1 6	1 4	1 6	1 5	1 5	1 6	1 5	1 5
QUALIFIER	UX	X	X	JX		J			
DETECTION LIMIT	2	2	2	2	2	2	2	2	2
NOTES						dissolved	dissolved	dissolved	dissolved

LOCATION	FD-371-3	FD-371COMP	FD-371MC	FD-444-460	FD-444-460	FD-559-561	FD-707-1	FD-771-1	FD-774-1
DATE	03-27-93	03-07-92	03-27-93	03-07-92	03-27-93	07-25-92	03-07-92	05-01-93	03-27-93
GROSS ALPHA (pCi/L)	8 00	6 00	0 20	2 00	2 00	3 00	6 00	5 00	9 00
ERROR	3	2	0 6	1	1	1	3	2	2
GROSS BETA (pCi/L)	10 00	6 00	4 00	3 00	2 00	2 00	8 00	16 00	15 00
ERROR	4	2	1	1	2	1	6	4	2

LOCATION	FD-883-1	FD-886-1	FD-886-2	FD-910	FD-991-1
DATE	05-01-93	05-01-93	05-01-93	05-01-93	04-26-93
GROSS ALPHA (pCi/L)	8 00	16 00	12 00	5 00	9 00
ERROR	2	2	2	1	4
GROSS BETA (pCi/L)	5 00	6 00	5 00	4 00	9 00
ERROR	2	2	1	2	8

NOTES.

GRRASP =

J = Estimated value, less than sample detection limit

U = Undetected. result was below the instrument detection limit

X = Result by calculation – GRRASP

= Exceeds 99/99 Upper tolerance limit for background stream water

4.2.3 Volatile and Semivolatile Organic Compounds

Most foundation drains and building sumps had been analyzed for VOCs and SVOCs only once as of November 1993. VOCs were detected in few samples at relatively low concentrations. VOCs were detected in samples from 11 of 19 sampling stations. Two of those stations yielded samples with considerable higher VOC concentrations Analytical results for VOCs and SVOCs are given in Tables 8 and 9, respectively, and Figure 22

Chloroform was detected in foundation drain water from station BS-111-1 (30 μg/L), FD-559-561 (6 μg/L, July 1992), FD-771-1 (45 μg/L, May 1993), and FD-910 (20 μg/L, May 1993 and 8 μg/L, April 1993) Carbon tetrachloride was detected in samples from FD-559-561 in July 1992 (220 μg/L) and March 1993 (320 μg/L), and from FD-771-1 (43 μg/L) Tetrachloroethene was detected in samples from FD-883-1 (6 μg/L, May 1993), FD-771-1 (1 μg/L, May 1993), and FD-559-561 (15 μg/L, July 1992, not detected, March 1993) Acetone concentrations exceeded the range of the laboratory instrument for a sample from BS-111-2 (490 μg/L, April 1993)

Samples from foundation drain FD-559-561 also contained 1,1,1-trichloroethane (13 μg/L, July 1992, 20 μg/L, March 1993), 1,1,2,2-tetrachloroethane (23 μg/L, March 1993), 1,1-dichloroethane (3 μg/L 1992; 6 μg/L, 1993), 1,1-dichloroethene (48 μg/L, July 1992; 74 μg/L, March 1993), 1,2-dichloroethene (17 μg/L, 1993), and TCE (160 μg/L, July 1993; 160 μg/L, March 1993).

Methylene chloride was detected in low concentrations in water from BS-111-2 (1 μg/L, March 1993), BS-865-2 (0.4 μg/L, March 1993), FD-371-3 (0.4 μg/L, March 1993), FD-371-MC (0.5 μg/L, March 1993), FD-444-460 (0.5 μg/L, March 1993), FD-559-561 (2 μg/L, March 1993), FD-771-1 (1 μg/L, May 1993), FD-886-1 (0.2 μg/L, June 1993), and FD-991-1 (1 μg/L, April

Table 8 – Foundation Drain and Building Sump Analytical Results

Volatile Organic Compounds

SAMPLE ID DATE COLLECTED	BS-111-2 04-26-93	BS-707-2 03-27-93	BS-865-1 03-27-93	BS-865-2 03-27-93	FD-371MC 03-27-93	FD-371-3 03-27-93	FD-444-460 03-27-93
1,1,1,2-TETRACHLOROETHANE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1,1,1-TRICHLOROETHANE	<5	<5	<5	<5	<5	<5	<5
1,1,2,2-TETRACHLOROETHANE	<5	<5	<5	<5	<5	<5	<5
1,1,2-TRICHLOROETHANE	<5	<5	<5	<5	<5	<5	<5
1,1-DICHLOROETHANE	<5	<5	<5	<5	<5	<5	<5
1,1-DICHLOROETHENE	<5	<5	<5	<5	<5	<5	<5
1,1-DICHLOROPROPENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1,2,3-TRICHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1,2,3-TRICHLOROPROPANE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DIBROMOETHANE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHANE	<5	<5	<5	<5	<5	<5	<5
1,2-DICHLOROETHENE	<5	<5	<5	<5	<5	<5	<5
1,2-DICHLOROPROPANE	<5	<5	<5	<5	<5	<5	<5
1,3-DICHLOROPROPANE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2,2-DICHLOROPROPANE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2-BUTANONE	<10	<10	<10	<10	<10	<10	<10
2-HEXANONE	<10	<10	<10	<10	<10	<10	<10
4-METHYL-2-PENTANONE	<10	<10	<10	<10	<10	<10	<10
ACETONE	490 E	<10	<10	<10	<10	<10	<10
BENZENE	<5	<5	<5	<5	<5	<5	<5
BENZENE 1,2,4-TRIMETHYL	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BENZENE, 1,3,5-TRIMETHYL	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BROMOBENZENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BROMOCHLOROMETHANE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BROMODICHLOROMETHANE	2 J	<5	<5	<5	<5	<5	<5
BROMOFORM	<5	<5	<5	<5	<5	<5	<5
BROMOMETHANE	<10	<10	<10	<10	<10	<10	<10
CARBON DISULFIDE	<5	<5	<5	<5	<5	<5	<5
CARBON TETRACHLORIDE	<5	<5	<5	<5	<5	<5	<5
CHLOROBENZENE	<5	<5	<5	<5	<5	<5	<5
CHLOROETHANE	<10	<10	<10	<10	<10	<10	<10
CHLOROFORM	30	<5	<5	<5	<5	<5	<5
CHLOROMETHANE	<10	<10	<10	<10	<10	<10	<10
cis-1,2-DICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
cis-1 3-DICHLOROPROPENE	<5	<5	<5	<5	<5	<5	<5
CUMENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DIBROMOCHLOROMETHANE	<5	<5	<5	<5	<5	<5	<5
DIBROMOMETHANE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DICHLORODIFLUOROMETHANE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ETHYLBENZENE	<5	<5	<5	<5	<5	<5	<5
METHYLENE CHLORIDE	1 BJ	<5	<5	0 4 BJ	0 5 BJ	0 4 BJ	0 5 BJ
m+p XYLENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
m+p XYLENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
n-BUTYLBENZENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
n-PROPYLBENZENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
o-CHLOROTOLUENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
o-XYLENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PROPANE, 1,2-DIBROMO-3-CHLORO	N/A	N/A	N/A	N/A	N/A	N/A	N/A
p-CHLOROTOLUENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
p-CYMENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
sec-BUTYLBENZENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STYRENE	<5	<5	<5	<5	<5	<5	<5
tert-BUTYLBENZENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TETRACHLOROETHENE	<5	<5	<5	<5	<5	<5	<5
TOLUENE	<5	<5	<5	<5	<5	<5	<5
TOTAL XYLENES	<5	<5	<5	<5	<5	<5	<5
trans-1,2-DICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
trans-1,3-DICHLOROPROPENE	<5	<5	<5	<5	<5	<5	<5
TRICHLOROETHENE	<5	<5	<5	<5	<5	<5	<5
TRICHLOROFLUOROMETHANE	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VINYL ACETATE	<10	<10	<10	<10	<10	<10	<10
VINYL CHLORIDE	<10	<10	<10	<10	<10	<10	<10

E = Concentration exceeds calibration range of instrument
B = Detected in blank
J = Detected below method detection limit

DRAFT
100% Recycled

Table 8 -- Foundation Drain and Building Sump Analytical Results

Volatile Organic Compounds

SAMPLE ID DATE COLLECTED	FD-559-561 07-25-92	FD-559-561 03-09-93	FD-771-1 05-01-93	FD-774-1 03-27-93	FD-883-1 05-01-93	FD-886-1 06-25-93	FD-886-1 05-01-93
1,1,1,2-TETRACHLOROETHANE	N/A	N/A	N/A	N/A	N/A	<1	N/A
1,1,1-TRICHLOROETHANE	13	20	<5	<5	<5	<1	<5
1,1,2,2-TETRACHLOROETHANE	<5	23	<5	<5	<5	<1	<5
1,1,2-TRICHLOROETHANE	<5	<5	<5	<5	<5	<1	<5
1,1-DICHLOROETHANE	3 J	6 J	<5	<5	<5	<1	<5
1,1-DICHLOROETHENE	48	74	<5	<5	<5	<1	<5
1,1-DICHLOROPROPENE	N/A	N/A	N/A	N/A	N/A	<1	N/A
1,2,3-TRICHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	<1	N/A
1,2,3-TRICHLOROPROPANE	N/A	N/A	N/A	N/A	N/A	<1	N/A
1,2-DIBROMOETHANE	N/A	N/A	N/A	N/A	N/A	<1	N/A
1,2-DICHLOROETHANE	<5	<5	<5	<5	<5	<1	<5
1,2-DICHLOROETHENE	<5	17 J	<5	<5	<5	N/A	<5
1,2-DICHLOROPROPANE	<5	<5	<5	<5	<5	<1	<5
1,3-DICHLOROPROPANE	N/A	N/A	N/A	N/A	N/A	<1	N/A
2,2-DICHLOROPROPANE	N/A	N/A	N/A	N/A	N/A	<1	N/A
2-BUTANONE	<10	<10	<10	<10	<10	N/A	<10
2-HEXANONE	<10	<10	<10	<10	<10	N/A	<10
4-METHYL-2-PENTANONE	<10	<10	<10	<10	<10	N/A	<10
ACETONE	<10	<10	<10	<10	<10	N/A	<10
BENZENE	<5	<5	<5	<5	<5	<1	<5
BENZENE, 1,2,4-TRIMETHYL	N/A	N/A	N/A	N/A	N/A	<1	N/A
BENZENE, 1,3,5-TRIMETHYL	N/A	N/A	N/A	N/A	N/A	<1	N/A
BROMOBENZENE	N/A	N/A	N/A	N/A	N/A	<1	N/A
BROMOCHLOROMETHANE	N/A	N/A	N/A	N/A	N/A	<1	N/A
BROMODICHLOROMETHANE	<5	<5	<5	<5	<5	<1	<5
BROMOFORM	<5	<5	<5	<5	<5	<1	<5
BROMOMETHANE	<10	<10	<10	<10	<10	<1	<10
CARBON DISULFIDE	<5	<5	<5	<5	<5	N/A	<5
CARBON TETRACHLORIDE	220	320	43	<5	<5	<1	<5
CHLOROBENZENE	<5	<5	<5	<5	<5	<1	<5
CHLOROETHANE	<10	<10	<10	<10	<10	<1	<10
CHLOROFORM	6	8 J	45	<5	<5	<1	<5
CHLOROMETHANE	<10	<10	<10	<10	<10	<1	<10
cis-1,2-DICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	<1	N/A
cis-1,3-DICHLOROPROPENE	<5	<5	<5	<5	<5	<1	<5
CUMENE	N/A	N/A	N/A	N/A	N/A	<1	N/A
DIBROMOCHLOROMETHANE	<5	<5	<5	<5	<5	<1	<5
DIBROMOMETHANE	N/A	N/A	N/A	N/A	N/A	<1	N/A
DICHLORODIFLUOROMETHANE	N/A	N/A	N/A	N/A	N/A	<1	N/A
ETHYLBENZENE	<5	<5	<5	<5	<5	<1	<5
METHYLENE CHLORIDE	<5	2 BJ	1 BJ	<5	<5	0.2 BJ	<5
m+p XYLENE	N/A	N/A	N/A	N/A	N/A	<1	N/A
m+p XYLENE	N/A	N/A	N/A	N/A	N/A	<1	N/A
n-BUTYLBENZENE	N/A	N/A	N/A	N/A	N/A	<1	N/A
n-PROPYLBENZENE	N/A	N/A	N/A	N/A	N/A	<1	N/A
o-CHLOROTOLUENE	N/A	N/A	N/A	N/A	N/A	<1	N/A
o-XYLENE	N/A	N/A	N/A	N/A	N/A	<1	N/A
PROPANE, 1,2-DIBROMO-3-CHLORO	N/A	N/A	N/A	N/A	N/A	<1	N/A
p-CHLOROTOLUENE	N/A	N/A	N/A	N/A	N/A	<1	N/A
p-CYMENE	N/A	N/A	N/A	N/A	N/A	<1	N/A
sec-BUTYLBENZENE	N/A	N/A	N/A	N/A	N/A	<1	N/A
STYRENE	<5	<5	<5	<5	<5	<1	<5
tert-BUTYLBENZENE	N/A	N/A	N/A	N/A	N/A	<1	N/A
TETRACHLOROETHENE	15	<5	1 J	<5	6	<1	<5
TOLUENE	<5	<5	<5	<5	<5	<1	<5
TOTAL XYLENES	<5	<5	<5	<5	<5	N/A	<5
trans-1,2-DICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	<1	N/A
trans-1,3-DICHLOROPROPENE	<5	<5	<5	<5	<5	<1	<5
TRICHLOROETHENE	160	160	<5	<5	<5	<1	<5
TRICHLOROFLUOROMETHANE	N/A	N/A	N/A	N/A	N/A	<1	N/A
VINYL ACETATE	<10	<10	<10	<10	<10	N/A	<10
VINYL CHLORIDE	<10	<10	<10	<10	<10	<1	<10

E = Concentration exceeds calibration range of instrument
B = Detected in blank
J = Detected below method detection limit

Table 8 – Foundation Drain and Building Sump Analytical Results

Volatile Organic Compounds

SAMPLE ID DATE COLLECTED	FD-886-2 05-01-93	FD-886-2 06-25-93	FD-910 05-01-93	FD-991-1 04-26-93	DSUMP 05-03-90
1,1,1,2-TETRACHLOROETHANE	N/A	<1	N/A	N/A	<5
1,1,1-TRICHLOROETHANE	<5	<1	<5	<5	N/A
1,1,2,2-TETRACHLOROETHANE	<5	<1	<5	<5	<5
1,1,2-TRICHLOROETHANE	<5	<1	<5	<5	<5
1,1-DICHLOROETHANE	<5	<1	<5	<5	<5
1,1-DICHLOROETHENE	<5	<1	<5	<5	<5
1,1-DICHLOROPROPENE	N/A	<1	N/A	N/A	N/A
1,2,3-TRICHLOROBENZENE	N/A	<1	N/A	N/A	N/A
1,2,3-TRICHLOROPROPANE	N/A	<1	N/A	N/A	N/A
1,2-DIBROMOETHANE	N/A	<1	N/A	N/A	N/A
1,2-DICHLOROETHANE	<5	<1	<5	<5	<5
1,2-DICHLOROETHENE	<5	N/A	<5	<5	250 E
1,2-DICHLOROPROPANE	<5	<1	<5	<5	<5
1,3-DICHLOROPROPANE	N/A	<1	N/A	N/A	N/A
2,2-DICHLOROPROPANE	N/A	<1	N/A	N/A	N/A
2-BUTANONE	<10	N/A	<10	<10	<10
2-HEXANONE	<10	N/A	<10	<10	<10
4-METHYL-2-PENTANONE	<10	N/A	<10	<10	<10
ACETONE	<10	N/A	<10	<10	<10
BENZENE	<5	<1	<5	<5	<5
BENZENE, 1,2,4-TRIMETHYL	N/A	<1	N/A	N/A	N/A
BENZENE, 1,3,5-TRIMETHYL	N/A	<1	N/A	N/A	N/A
BROMOBENZENE	N/A	<1	N/A	N/A	N/A
BROMOCHLOROMETHANE	N/A	<1	N/A	N/A	N/A
BROMODICHLOROMETHANE	<5	<1	1 J	<5	<5
BROMOFORM	<5	<1	<5	<5	<5
BROMOMETHANE	<10	<1	<10	<10	<10
CARBON DISULFIDE	<5	N/A	<5	<5	<5
CARBON TETRACHLORIDE	<5	<1	<5	<5	<5
CHLOROBENZENE	<5	<1	<5	<5	<5
CHLOROETHANE	<10	<1	<10	<10	<10
CHLOROFORM	<5	<1	20	<5	<5
CHLOROMETHANE	<10	<1	<10	<10	<10
cis-1,2-DICHLOROETHENE	N/A	<1	N/A	N/A	N/A
cis-1,3-DICHLOROPROPENE	<5	<1	<5	<5	<5
CUMENE	N/A	<1	N/A	N/A	N/A
DIBROMOCHLOROMETHANE	<5	<1	<5	<5	<5
DIBROMOMETHANE	N/A	<1	N/A	N/A	N/A
DICHLORODIFLUOROMETHANE	N/A	<1	N/A	N/A	N/A
ETHYLBENZENE	<5	<1	<5	<5	<5
METHYLENE CHLORIDE	<5	<1	<5	1 BJ	<5
m+p XYLENE	N/A	<1	N/A	N/A	N/A
m+p XYLENE	N/A	<1	N/A	N/A	N/A
n-BUTYLBENZENE	N/A	<1	N/A	N/A	N/A
n-PROPYLBENZENE	N/A	<1	N/A	N/A	N/A
o-CHLOROTOLUENE	N/A	<1	N/A	N/A	N/A
o-XYLENE	N/A	<1	N/A	N/A	N/A
PROPANE, 1,2-DIBROMO-3-CHLORO	N/A	<1	N/A	N/A	N/A
p-CHLOROTOLUENE	N/A	<1	N/A	N/A	N/A
p-CYMENE	N/A	<1	N/A	N/A	N/A
sec-BUTYLBENZENE	N/A	<1	N/A	N/A	N/A
STYRENE	<5	<1	<5	<5	<5
tert-BUTYLBENZENE	N/A	<1	N/A	N/A	N/A
TETRACHLOROETHENE	<5	<1	<5	<5	7
TOLUENE	<5	<1	<5	<5	<5
TOTAL XYLENES	<5	N/A	<5	<5	<5
trans-1,2-DICHLOROETHENE	N/A	<1	N/A	N/A	N/A
trans-1,3-DICHLOROPROPENE	<5	<1	<5	<5	<5
TRICHLOROETHENE	<5	<1	<5	<5	<5
TRICHLOROFLUOROMETHANE	N/A	<1	N/A	N/A	N/A
VINYL ACETATE	<10	N/A	<10	<10	<10
VINYL CHLORIDE	<10	<1	<10	<10	<10

E = Concentration exceeds calibration range of instrument
B = Detected in blank
J = Detected below method detection limit

NOTES All results in micrograms per liter
Data were not validated, qualifiers were assigned by the laboratory
< = Compound was analyzed but not detected Value shown is the instrument detection limit.
N/A = not analyzed

Table 9 – Foundation Drain and Building Sump Analytical Results

Semivolatile Organic Compounds

SAMPLE ID DATE COLLECTED	BS-111-2 04-26-93	BS-707-2 03-27-93	BS-865-1 03-27-93	BS-865-2 03-27-93	FD-371MC 03-27-93	FD-371-3 03-27-93	FD-444-460 03-27-93
1,2,4-TRICHLOROBENZENE	N/A	<5	<5	<5	<5	<5	<5
1,2-DICHLOROBENZENE	N/A	<5	<5	<5	<5	<5	<5
1,3-DICHLOROBENZENE	N/A	<5	<5	<5	<5	<5	<5
1,4-DICHLOROBENZENE	N/A	<5	<5	<5	<5	<5	<5
2,4,5-TRICHLOROPHENOL	N/A	<25	<25	<25	<25	<25	<25
2,4,6-TRICHLOROPHENOL	N/A	<5	<5	<5	<5	<5	<5
2,4-DICHLOROPHENOL	N/A	<5	<5	<5	<5	<5	<5
2,4-DIMETHYLPHENOL	N/A	<5	<5	<5	<5	<5	<5
2,4-DINITROPHENOL	N/A	<25	<25	<25	<25	<25	<25
2,4-DINITROTOLUENE	N/A	<5	<5	<5	<5	<5	<5
2,6-DINITROTOLUENE	N/A	<5	<5	<5	<5	<5	<5
2-CHLORONAPHTHALENE	N/A	<5	<5	<5	<5	<5	<5
2-CHLOROPHENOL	N/A	<5	<5	<5	<5	<5	<5
2-METHYLNAPHTHALENE	N/A	<5	<5	<5	<5	<5	<5
2-METHYLPHENOL	N/A	<5	<5	<5	<5	<5	<5
2-NITROANILINE	N/A	<25	<25	<25	<25	<25	<25
2-NITROPHENOL	N/A	<5	<5	<5	<5	<5	<5
3,3'-DICHLOROBENZIDINE	N/A	<10	<10	<10	<10	<10	<10
3-NITROANILINE	N/A	<25	<25	<25	<25	<25	<25
4,6-DINITRO-2-METHYLPHENOL	N/A	<25	<25	<25	<25	<25	<25
4-BROMOPHENYL PHENYL ETHER	N/A	<5	<5	<5	<5	<5	<5
4-CHLOROANILINE	N/A	<5	<5	<5	<5	<5	<5
4-CHLOROPHENYL PHENYL ETHER	N/A	<5	<5	<5	<5	<5	<5
4-CHLORO-3-METHYLPHENOL	N/A	<5	<5	<5	<5	<5	<5
4-METHYLPHENOL	N/A	<5	<5	<5	<5	<5	<5
4-NITROANILINE	N/A	<25	<25	<25	<25	<25	<25
4-NITROPHENOL	N/A	<25	<25	<25	<25	<25	<25
ACENAPHTHENE	N/A	<5	<5	<5	<5	0 5 J	<5
ACENAPHTHYLENE	N/A	<5	<5	<5	<5	<5	<5
ANTHRACENE	N/A	<5	<5	<5	<5	<5	<5
BENZOIC ACID	N/A	<25	<25	<25	<25	<25	<25
BENZO(a)ANTHRACENE	N/A	<5	<5	<5	<5	<5	<5
BENZO(a)PYRENE	N/A	<5	<5	<5	<5	<5	<5
BENZO(b)FLUORANTHENE	N/A	<5	<5	<5	<5	<5	<5
BENZO(ghi)PERYLENE	N/A	<5	<5	<5	<5	<5	<5
BENZO(k)FLUORANTHENE	N/A	<5	<5	<5	<5	<5	<5
BENZYL ALCOHOL	N/A	<5	<5	<5	<5	<5	<5
BIS(2-CHLOROETHOXY)METHANE	N/A	<5	<5	<5	<5	<5	<5
BIS(2-CHLOROETHYL)ETHER	N/A	<5	<5	<5	<5	<5	<5
BIS(2-CHLOROISOPROPYL)ETHER	N/A	<5	<5	<5	<5	<5	<5
BIS(2-ETHYLHEXYL)PHTHALATE	N/A	2 BJ	1 BJ	1 BJ	22 B	6 B	3 BJ
BUTYL BENZYL PHTHALATE	N/A	<5	0 6 J	0 6 J	<5	<5	<5
CHRYSENE	N/A	<5	<5	<5	<5	<5	<5
DIBENZOFURAN	N/A	<5	<5	<5	<5	<5	<5
DIBENZO(a,h)ANTHRACENE	N/A	<5	<5	<5	<5	<5	<5
DIETHYL PHTHALATE	N/A	<5	<5	<5	<5	<5	<5
DIMETHYL PHTHALATE	N/A	<5	<5	<5	<5	<5	<5
DI-n-BUTYL PHTHALATE	N/A	<5	<5	<5	<5	<5	<5
DI-n-OCTYL PHTHALATE	N/A	<5	<5	<5	<5	<5	<5
FLUORANTHENE	N/A	<5	<5	<5	<5	<5	<5
FLUORENE	N/A	<5	<5	<5	<5	<5	<5
HEXACHLOROBENZENE	N/A	<5	<5	<5	<5	<5	<5
HEXACHLOROBUTADIENE	N/A	<5	<5	<5	<5	<5	<5
HEXACHLOROCYCLOPENTADIENE	N/A	<5	<5	<5	<5	<5	<5
HEXACHLOROETHANE	N/A	<5	<5	<5	<5	<5	<5
INDENO(1,2,3-cd)PYRENE	N/A	<5	<5	<5	<5	<5	<5
ISOPHORONE	N/A	<5	<5	<5	<5	<5	<5
NAPHTHALENE	N/A	<5	<5	<5	<5	<5	<5
NITROBENZENE	N/A	<5	<5	<5	<5	<5	<5
N-NITROSODIPHENYLAMINE	N/A	<5	<5	<5	<5	<5	<5
N-NITROSO-DI-n-PROPYLAMINE	N/A	<5	<5	<5	<5	<5	<5
PENTACHLOROPHENOL	N/A	<25	<25	<25	<25	<25	<25
PHENANTHRENE	N/A	<5	<5	<5	<5	<5	<5
PHENOL	N/A	<5	<5	<5	<5	<5	<5
PYRENE	N/A	<5	<5	<5	<5	<5	<5

Table 9 – Foundation Drain and Building Sump Analytical Results

Semivolatile Organic Compounds

SAMPLE ID DATE COLLECTED	FD-559-561 07-25-92	FD-559-561 03-09-93	FD-771-1 05-01-93	FD-774-1 03-27-93	FD-883-1 05-01-93	FD-886-1 06-25-93	FD-886-1 05-01-93
1,2,4-TRICHLOROBENZENE	<5	N/A	<5	<5	<5	<1	<5
1,2-DICHLOROBENZENE	<5	N/A	<5	<5	<5	<1	<5
1,3-DICHLOROBENZENE	<5	N/A	<5	<5	<5	<1	<5
1,4-DICHLOROBENZENE	<5	N/A	<5	<5	<5	<1	<5
2,4,5-TRICHLOROPHENOL	<25	N/A	<25	<25	<25	N/A	<25
2,4,6-TRICHLOROPHENOL	<5	N/A	<5	<5	<5	N/A	<5
2,4-DICHLOROPHENOL	<5	N/A	<5	<5	<5	N/A	<5
2,4-DIMETHYLPHENOL	<5	N/A	<5	<5	<5	N/A	<5
2,4-DINITROPHENOL	<25	N/A	<25	<25	<25	N/A	<25
2,4-DINITROTOLUENE	<5	N/A	<5	<5	<5	N/A	<5
2,6-DINITROTOLUENE	<5	N/A	<5	<5	<5	N/A	<5
2-CHLORONAPHTHALENE	<5	N/A	<5	<5	<5	N/A	<5
2-CHLOROPHENOL	<5	N/A	<5	<5	<5	N/A	<5
2-METHYLNAPHTHALENE	<5	N/A	<5	<5	<5	N/A	<5
2-METHYLPHENOL	<5	N/A	<5	<5	<5	N/A	<5
2-NITROANILINE	<25	N/A	<25	<25	<25	N/A	<25
2-NITROPHENOL	<5	N/A	<5	<5	<5	N/A	<5
3,3'-DICHLOROBENZIDINE	<10	N/A	<10	<10	<10	N/A	<10
3-NITROANILINE	<25	N/A	<25	<25	<25	N/A	<25
4,6-DINITRO-2-METHYLPHENOL	<25	N/A	<25	<25	<25	N/A	<25
4-BROMOPHENYL PHENYL ETHER	<5	N/A	<5	<5	<5	N/A	<5
4-CHLOROANILINE	<5	N/A	<5	<5	<5	N/A	<5
4-CHLOROPHENYL PHENYL ETHER	<5	N/A	<5	<5	<5	N/A	<5
4-CHLORO-3-METHYLPHENOL	<5	N/A	<5	<5	<5	N/A	<5
4-METHYLPHENOL	<5	N/A	<5	<5	<5	N/A	<5
4-NITROANILINE	<25	N/A	<25	<25	<25	N/A	<25
4-NITROPHENOL	<25	N/A	<25	<25	<25	N/A	<25
ACENAPHTHENE	<5	N/A	<5	<5	<5	N/A	<5
ACENAPHTHYLENE	<5	N/A	<5	<5	<5	N/A	<5
ANTHRACENE	<5	N/A	<5	<5	<5	N/A	<5
BENZOIC ACID	<25	N/A	<25	<25	<25	N/A	<25
BENZO(a)ANTHRACENE	<5	N/A	<5	<5	<5	N/A	<5
BENZO(a)PYRENE	<5	N/A	<5	<5	<5	N/A	<5
BENZO(b)FLUORANTHENE	<5	N/A	<5	<5	<5	N/A	<5
BENZO(ghi)PERYLENE	<5	N/A	<5	<5	<5	N/A	<5
BENZO(k)FLUORANTHENE	<5	N/A	<5	<5	<5	N/A	<5
BENZYL ALCOHOL	<5	N/A	<5	<5	<5	N/A	<5
BIS(2-CHLOROETHOXY)METHANE	<5	N/A	<5	<5	<5	N/A	<5
BIS(2-CHLOROETHYL)ETHER	<5	N/A	<5	<5	<5	N/A	<5
BIS(2-CHLOROISOPROPYL)ETHER	<5	N/A	<5	<5	<5	N/A	<5
BIS(2-ETHYLHEXYL)PHTHALATE	<5	N/A	<5	2 BJ	2 J	N/A	2 J
BUTYL BENZYL PHTHALATE	<5	N/A	<5	<5	<5	N/A	<5
CHRYSENE	<5	N/A	<5	<5	<5	N/A	<5
DIBENZOFURAN	<5	N/A	<5	<5	<5	N/A	<5
DIBENZO(a,h)ANTHRACENE	<5	N/A	<5	<5	<5	N/A	<5
DIETHYL PHTHALATE	<5	N/A	<5	<5	<5	N/A	<5
DIMETHYL PHTHALATE	<5	N/A	<5	<5	<5	N/A	<5
DI-n-BUTYL PHTHALATE	<5	N/A	<5	<5	<5	N/A	<5
DI-n-OCTYL PHTHALATE	<5	N/A	<5	<5	<5	N/A	<5
FLUORANTHENE	<5	N/A	<5	<5	<5	N/A	<5
FLUORENE	<5	N/A	<5	<5	<5	N/A	<5
HEXACHLOROBENZENE	<5	N/A	<5	<5	<5	N/A	<5
HEXACHLOROBUTADIENE	<5	N/A	<5	<5	<5	<1	<5
HEXACHLOROCYCLOPENTADIENE	<5	N/A	<5	<5	<5	N/A	<5
HEXACHLOROETHANE	<5	N/A	<5	<5	<5	N/A	<5
INDENO(1,2,3-cd)PYRENE	<5	N/A	<5	<5	<5	N/A	<5
ISOPHORONE	<5	N/A	<5	<5	<5	N/A	<5
NAPHTHALENE	<5	N/A	<5	<5	<5	<1	<5
NITROBENZENE	<5	N/A	<5	<5	<5	N/A	<5
N-NITROSODIPHENYLAMINE	<5	N/A	<5	<5	<5	N/A	<5
N-NITROSO-DI-n-PROPYLAMINE	<5	N/A	<5	<5	<5	N/A	<5
PENTACHLOROPHENOL	<25	N/A	<25	<25	<25	N/A	<25
PHENANTHRENE	<5	N/A	<5	<5	<5	N/A	<5
PHENOL	<5	N/A	<5	<5	<5	N/A	<5
PYRENE	<5	N/A	<5	<5	<5	N/A	<5

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Table 9 – Foundation Drain and Building Sump Analytical Results

Semivolatile Organic Compounds

SAMPLE ID DATE COLLECTED	FD-886-2 05-01-93	FD-886-2 06-25-93	FD-910 05-01-93	FD-991-1 04-26-93	DSUMP 05-03-90
1,2,4-TRICHLOROBENZENE	<5	<1	<5	<5	N/A
1,2-DICHLOROBENZENE	<5	<1	<5	<5	N/A
1,3-DICHLOROBENZENE	<5	<1	<5	<5	N/A
1,4-DICHLOROBENZENE	<5	<1	<5	<5	N/A
2,4,5-TRICHLOROPHENOL	<25	N/A	<25	<25	N/A
2,4,6-TRICHLOROPHENOL	<5	N/A	<5	<5	N/A
2,4-DICHLOROPHENOL	<5	N/A	<5	<5	N/A
2,4-DIMETHYLPHENOL	<5	N/A	<5	<5	N/A
2,4-DINITROPHENOL	<25	N/A	<25	<25	N/A
2,4-DINITROTOLUENE	<5	N/A	<5	<5	N/A
2,6-DINITROTOLUENE	<5	N/A	<5	<5	N/A
2-CHLORONAPHTHALENE	<5	N/A	<5	<5	N/A
2-CHLOROPHENOL	<5	N/A	<5	<5	N/A
2-METHYLNAPHTHALENE	<5	N/A	<5	<5	N/A
2-METHYLPHENOL	<5	N/A	<5	<5	N/A
2-NITROANILINE	<25	N/A	<25	<25	N/A
2-NITROPHENOL	<5	N/A	<5	<5	N/A
3,3'-DICHLOROBENZIDINE	<10	N/A	<10	<10	N/A
3-NITROANILINE	<25	N/A	<25	<25	N/A
4,6-DINITRO-2-METHYLPHENOL	<25	N/A	<25	<25	N/A
4-BROMOPHENYL PHENYL ETHER	<5	N/A	<5	<5	N/A
4-CHLOROANILINE	<5	N/A	<5	<5	N/A
4-CHLOROPHENYL PHENYL ETHER	<5	N/A	<5	<5	N/A
4-CHLORO-3-METHYLPHENOL	<5	N/A	<5	<5	N/A
4-METHYLPHENOL	<5	N/A	<5	<5	N/A
4-NITROANILINE	<25	N/A	<25	<25	N/A
4-NITROPHENOL	<25	N/A	<25	<25	N/A
ACENAPHTHENE	<5	N/A	<5	<5	N/A
ACENAPHTHYLENE	<5	N/A	<5	<5	N/A
ANTHRACENE	<5	N/A	<5	<5	N/A
BENZOIC ACID	<25	N/A	<25	<25	N/A
BENZO(a)ANTHRACENE	<5	N/A	<5	<5	N/A
BENZO(a)PYRENE	<5	N/A	<5	<5	N/A
BENZO(b)FLUORANTHENE	<5	N/A	<5	<5	N/A
BENZO(ghi)PERYLENE	<5	N/A	<5	<5	N/A
BENZO(k)FLUORANTHENE	<5	N/A	<5	<5	N/A
BENZYL ALCOHOL	<5	N/A	<5	<5	N/A
BIS(2-CHLOROETHOXY)METHANE	<5	N/A	<5	<5	N/A
BIS(2-CHLOROETHYL)ETHER	<5	N/A	<5	<5	N/A
BIS(2-CHLOROISOPROPYL)ETHER	<5	N/A	<5	<5	N/A
BIS(2-ETHYLHEXYL)PHTHALATE	<5	N/A	<5	<5	N/A
BUTYL BENZYL PHTHALATE	<5	N/A	<5	<5	N/A
CHRYSENE	<5	N/A	<5	<5	N/A
DIBENZOFURAN	<5	N/A	<5	<5	N/A
DIBENZO(a,h)ANTHRACENE	<5	N/A	<5	<5	N/A
DIETHYL PHTHALATE	<5	N/A	<5	<5	N/A
DIMETHYL PHTHALATE	<5	N/A	<5	<5	N/A
DI-n-BUTYL PHTHALATE	<5	N/A	<5	<5	N/A
DI-n-OCTYL PHTHALATE	<5	N/A	<5	<5	N/A
FLUORANTHENE	<5	N/A	<5	<5	N/A
FLUORENE	<5	N/A	<5	<5	N/A
HEXACHLOROBENZENE	<5	N/A	<5	<5	N/A
HEXACHLOROBUTADIENE	<5	<1	<5	<5	N/A
HEXACHLOROCYCLOPENTADIENE	<5	N/A	<5	<5	N/A
HEXACHLOROETHANE	<5	N/A	<5	<5	N/A
INDENO(1,2,3-cd)PYRENE	<5	N/A	<5	<5	N/A
ISOPHORONE	<5	N/A	<5	<5	N/A
NAPHTHALENE	<5	<1	<5	<5	N/A
NITROBENZENE	<5	N/A	<5	<5	N/A
N-NITROSODIPHENYLAMINE	<5	N/A	<5	<5	N/A
N-NITROSO-DI-n-PROPYLAMINE	<5	N/A	<5	<5	N/A
PENTACHLOROPHENOL	<25	N/A	<25	<25	N/A
PHENANTHRENE	<5	N/A	<5	<5	N/A
PHENOL	<5	N/A	<5	<5	N/A
PYRENE	<5	N/A	<5	<5	N/A

NOTES

All results in micrograms per liter
Data were not validated
B = compound detected in the blank
J = concentration is below method detection limits
N/A = not analyzed
< = Compound was analyzed but not detected. Value shown is the instrument detection limit.

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1993) In every case, methylene chloride was also detected in the laboratory blank sample and detected below the method detection limit in these samples Low concentrations of bromodichloromethane (BS-111-2, 2 μg/L, April 1993; FD-910, 1 μg/L, May 1993), acenaphthene (FD-371-3, 0 5 μg/L, March 1993), and butyl benzyl phthalate (BS-865-1, 0.6 μg/L, March 1993, BS-865-2, 0 6 μg/L, March 1993) were also reported Bis(2-ethylhexyl)phthalate was detected in nine samples, at values ranging from 1 (estimated and in detected in the laboratory blank) to 22 μg/L However, the compound was also detected in the trip blank (FD-910-TB) at 23 μg/L

4.2.4 Water Quality Parameters

Samples are also analyzed for water quality parameters. Nitrate, specific conductivity, pH, and total dissolved solids have been analyzed in the field during every sampling event These results are included in Table 5, for the 1977 to 1991 data set, and in Table 10 for the 1992 to 1993 sampling events

4.3 TREND ANALYSIS

Analytical results for gross alpha, gross beta, and selected metals were plotted for each sampling station to evaluate any trends in analytical results over time. Analytical technologies and procedures have evolved over time, and those changes could have more impact on the reported results than actual concentration of analytes The trend analysis indicates that the reported gross alpha and beta concentrations generally exhibit decreasing concentrations from 1977 to 1993 Trends in metals concentrations are more difficult to recognize. Temporal evaluations and the accompanying graphs for selected sampling stations are presented below. Gross alpha and gross beta results were graphed on a linear scale, and metal concentrations were graphed logarithmically A "<" symbol on the graphs indicates a result less than the instrument

Table 10 – Foundation Drain and Building Sump Analytical Results
1992 – 1993
Water Quality Parameters

Sample ID	BS-111-2	BS-707-2	BS-707-2	BS-865-1	BS-865-1	BS-865-2	BS-865-2-D	BS-883-1
Date Collected	04-26-93	03-07-92	03-27-93	03-07-92	03-27-93	03-27-93	03-27-93	03-07-92
Nitrate	1.01	N/A	1.65	3.12	1.33	3.61	3.65	1.51
Nitrate/Nitrite	N/A	1.33	N/A	N/A	N/A	N/A	N/A	N/A
Specific Conductivity	N/A	445	N/A	436	N/A	N/A	N/A	214
Total Dissolved Solids	205	335	398	293	316	436	437	157

Sample ID	FD-111-1	FD-371COMP	FD-371MC	FD-371-3	FD-371-3	FD-444-460	FD-444-460	FD-559-561	FD-707-1
Date Collected	03-07-92	03-07-92	03-27-93	03-07-92	03-27-93	03-07-92	03-27-93	07-25-92	03-07-92
Nitrate	N/A	N/A	0.85	N/A	0.53	N/A	7.9	3.45	1.98
Nitrate/Nitrite	1.84	2.11	N/A	1.56	N/A	7.73	N/A	N/A	N/A
Specific Conductivity	372	457	N/A	467	N/A	510	N/A	N/A	638
Total Dissolved Solids	270	320	169	313	744	417	408	269	413

Sample ID	FD-771-1	FD-774-1	FD-883-1	FD-886-1	FD-886-1-D	FD-886-2	FD-910	FD-910-D	FD-991-1
Date Collected	05-01-93	03-27-93	05-01-93	05-01-93	05-01-93	05-01-93	05-01-93	05-01-93	04-26-93
Nitrate	5.31	7.64	5.84	3.93	N/A	3.79	3.92	N/A	1.65
Nitrate/Nitrite	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Specific Conductivity	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total Dissolved Solids	367	354	586	371	368	345	413	404	612

NOTES N/A = Not Analyzed
Results in mg/l (milligrams per liter), except specific conductivity (in micromhos)

detection limit. A "*" symbol indicates that the sample was not analyzed for that element.

4.3.1 Concentration Trends - 100 Area

Gross alpha and gross beta concentrations generally decreased at Station FD-111-1, from 1978 to 1992 (Figure 23). Aluminum and manganese concentrations also decreased from 1989 to 1991, based on three sampling events (Figure 24). Trend analysis for other analytes at FD-111-1 was inconclusive.

4.3.2 Concentration Trends - 300 Area

Gross alpha and gross beta concentrations at sample station FD-371-1 and FD-371-2 exhibited inconclusive trends from 1977 through 1980 (Figure 25) and from 1977 through 1991 (Figure 26) Sample station FD-371-3 exhibited a trend of increasing gross alpha and gross beta concentrations between 1981 and 1988, followed by generally decreasing concentrations through 1990 (Figure 27) Gross alpha and gross beta concentrations at station FD-371-Comp appear to have decreased from April to December 1988, increased in 1988 and 1989, then decreased through 1991 (Figure 28)

The concentrations of selected metals in water from station FD-371-3 are presented in Figures 29 and 30. Results are variable for aluminum, manganese, copper, arsenic and lead, in samples collected at FD-371-3 from 1988 through 1990. Samples collected at station FD-371-composite exhibited decreasing aluminum concentrations from 1989 through 1991 (Figure 31).

Figure 23- Gross Alpha and Gross Beta Concentrations at Sample Station FD-111-1

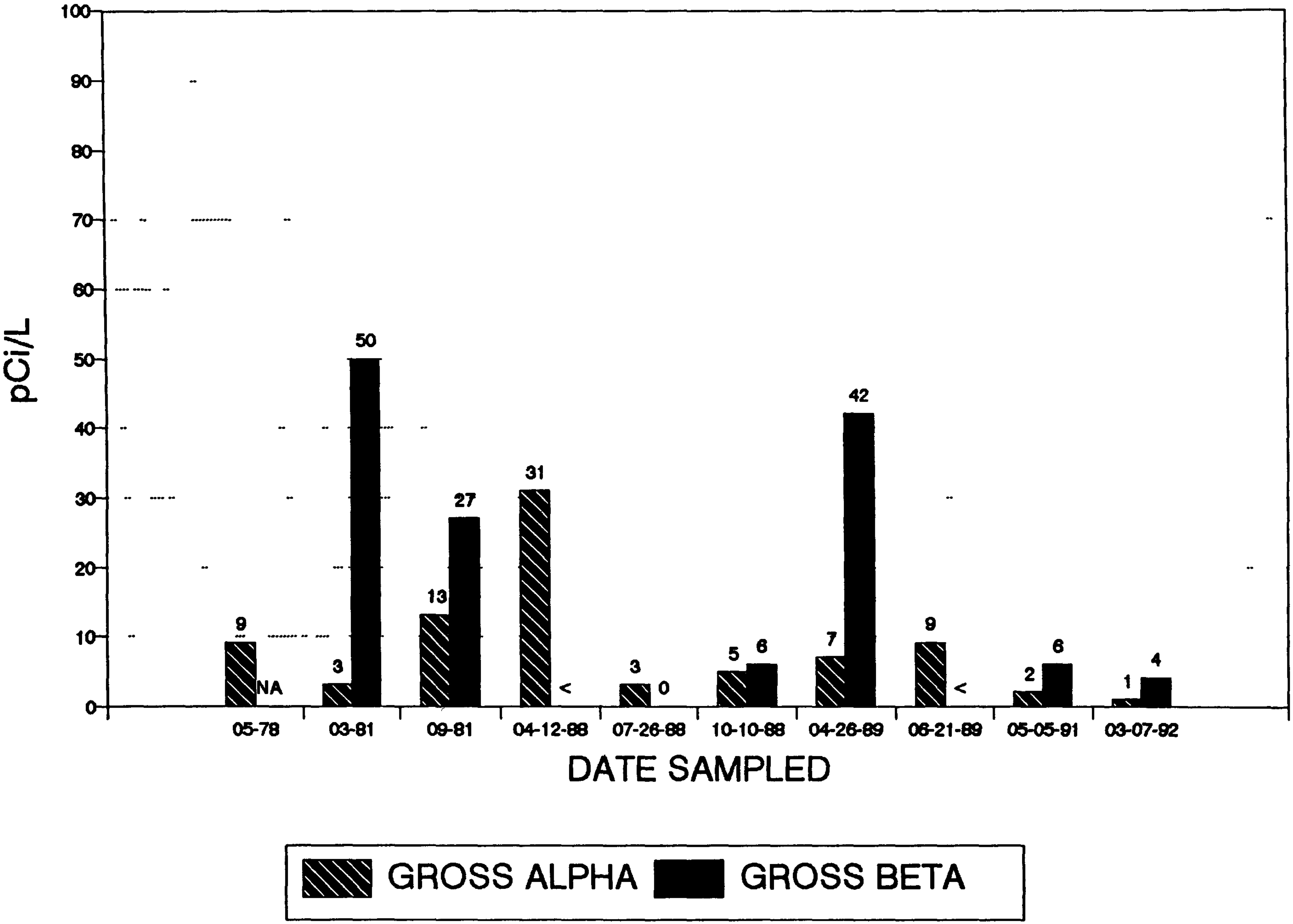

Figure 24- Metals Concentrations at Sample Station FD-111-1

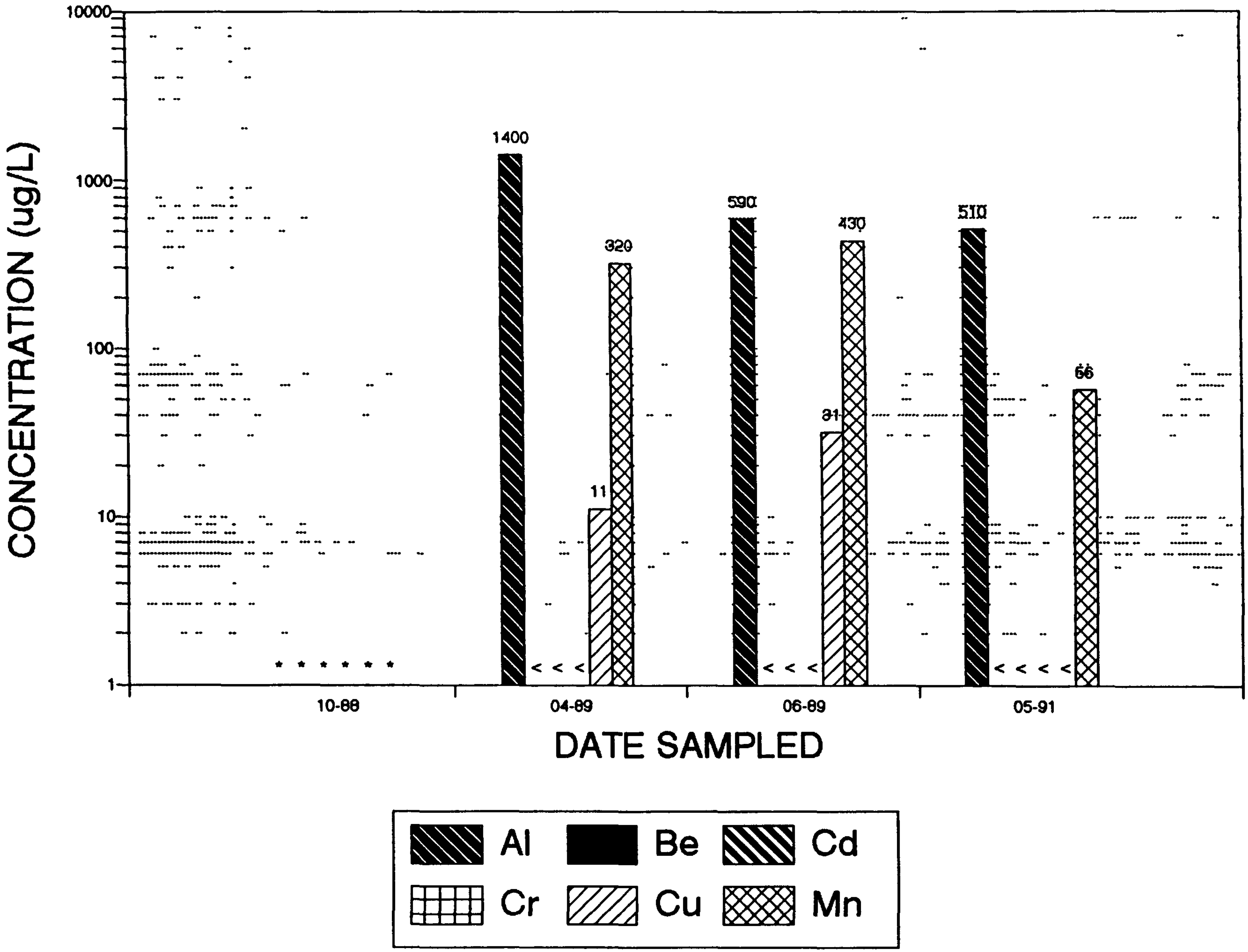

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Figure 25- Gross Alpha and Gross Beta Concentrations at Sample Station FD-371-1- 1977 through 1980

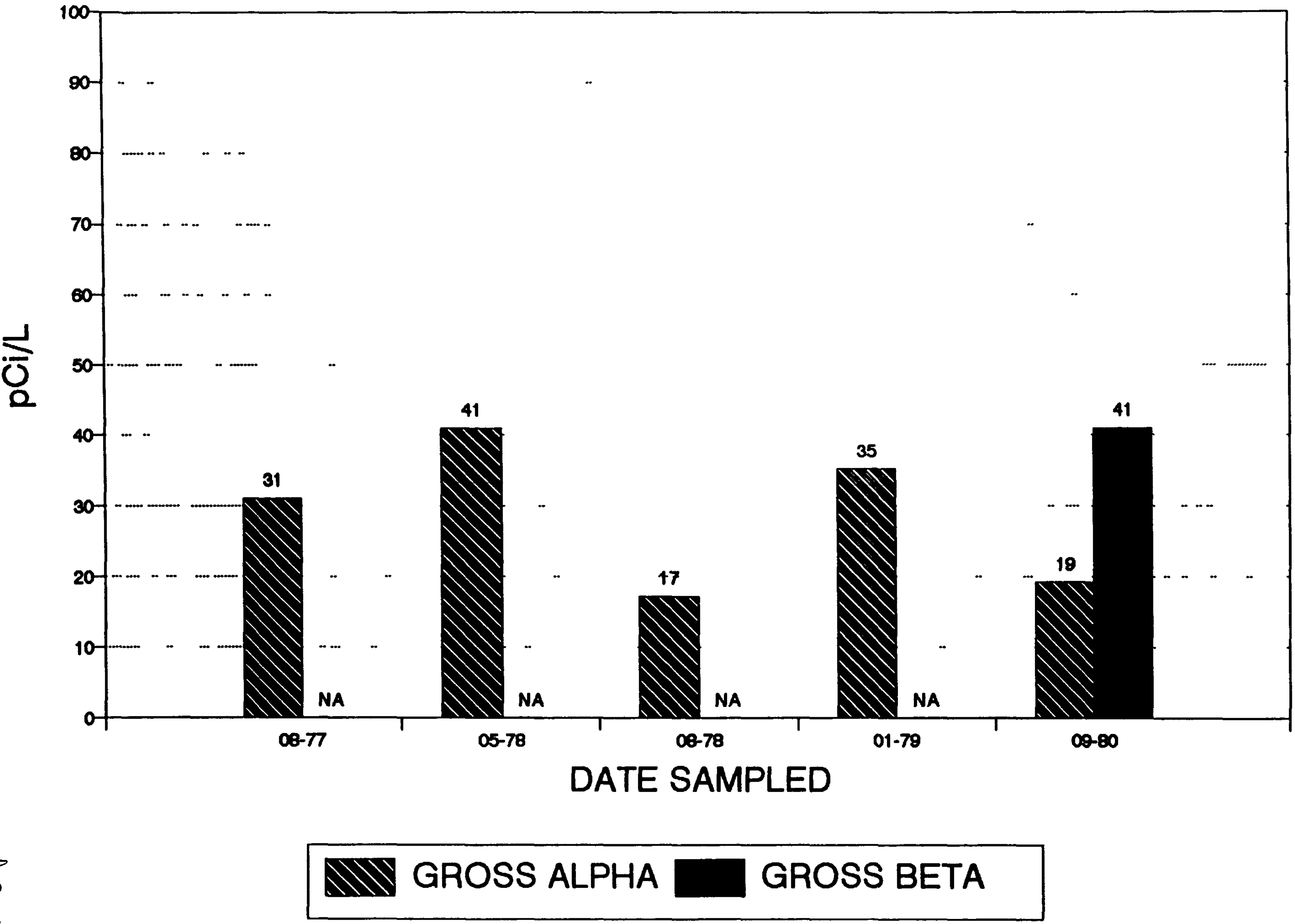

Figure 26- Gross Alpha and Gross Beta Concentrations at Sample Station FD-371-2- 1977 through 1991

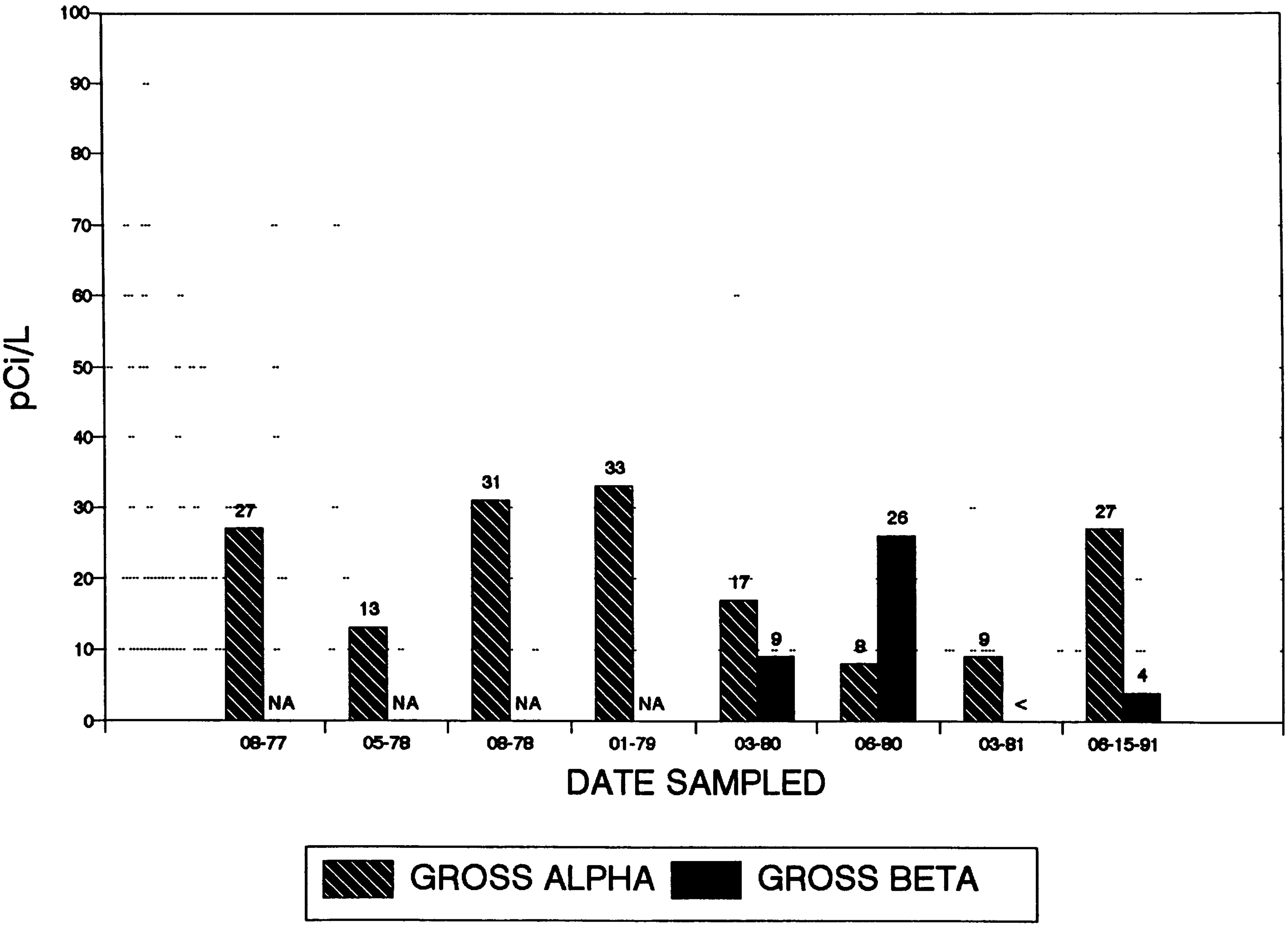

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Figure 27- Gross Alpha and Gross Beta Concentrations at Sample Station FD-371-3- 1981 through 1990

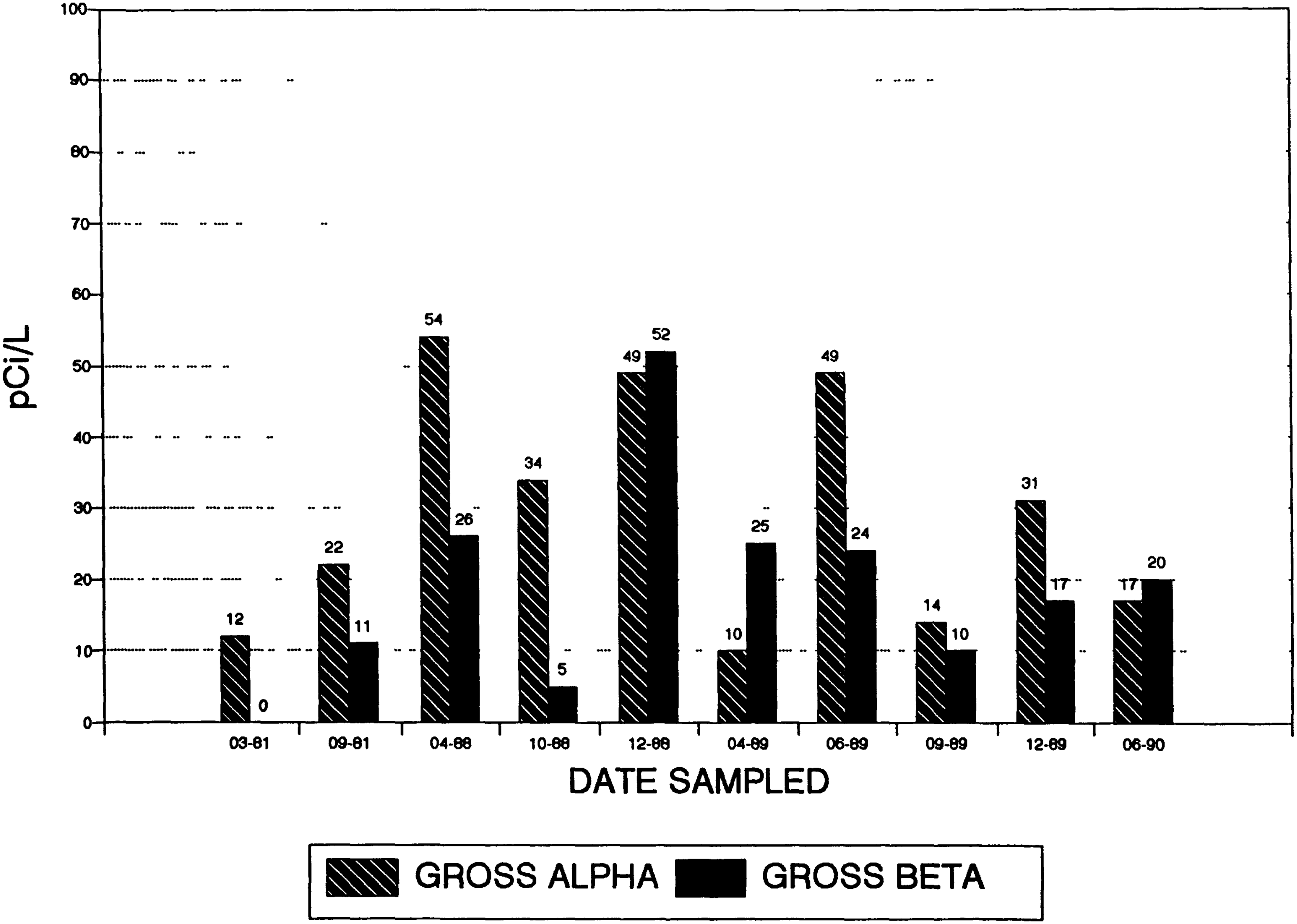

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Figure 28- Gross Alpha and Gross Beta Concentrations at Sample Station FD-371-Composite- 1988 through 1991

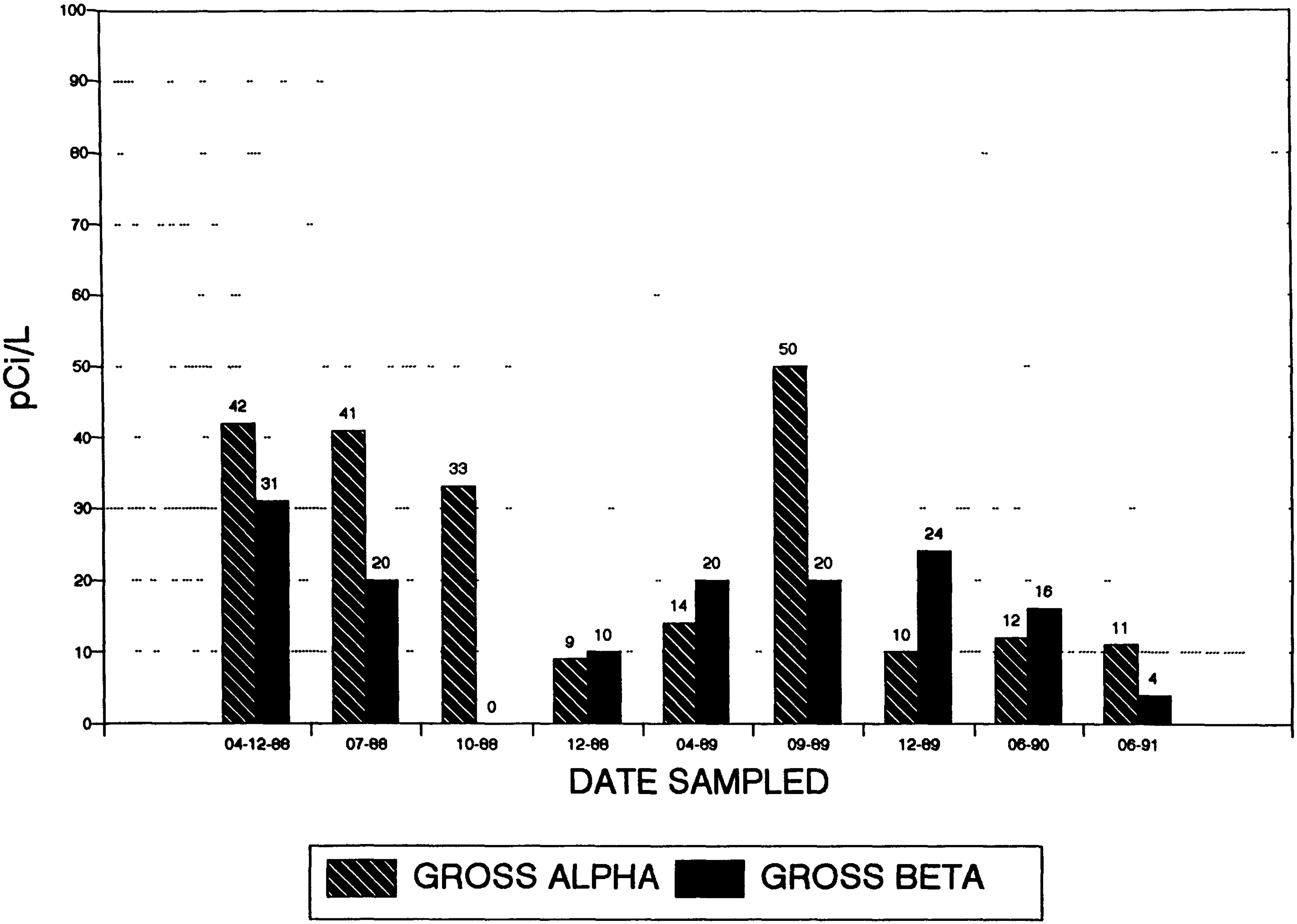

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Figure 29- Metals Concentrations at Sample Station FD-371-3- 1988 through 1990

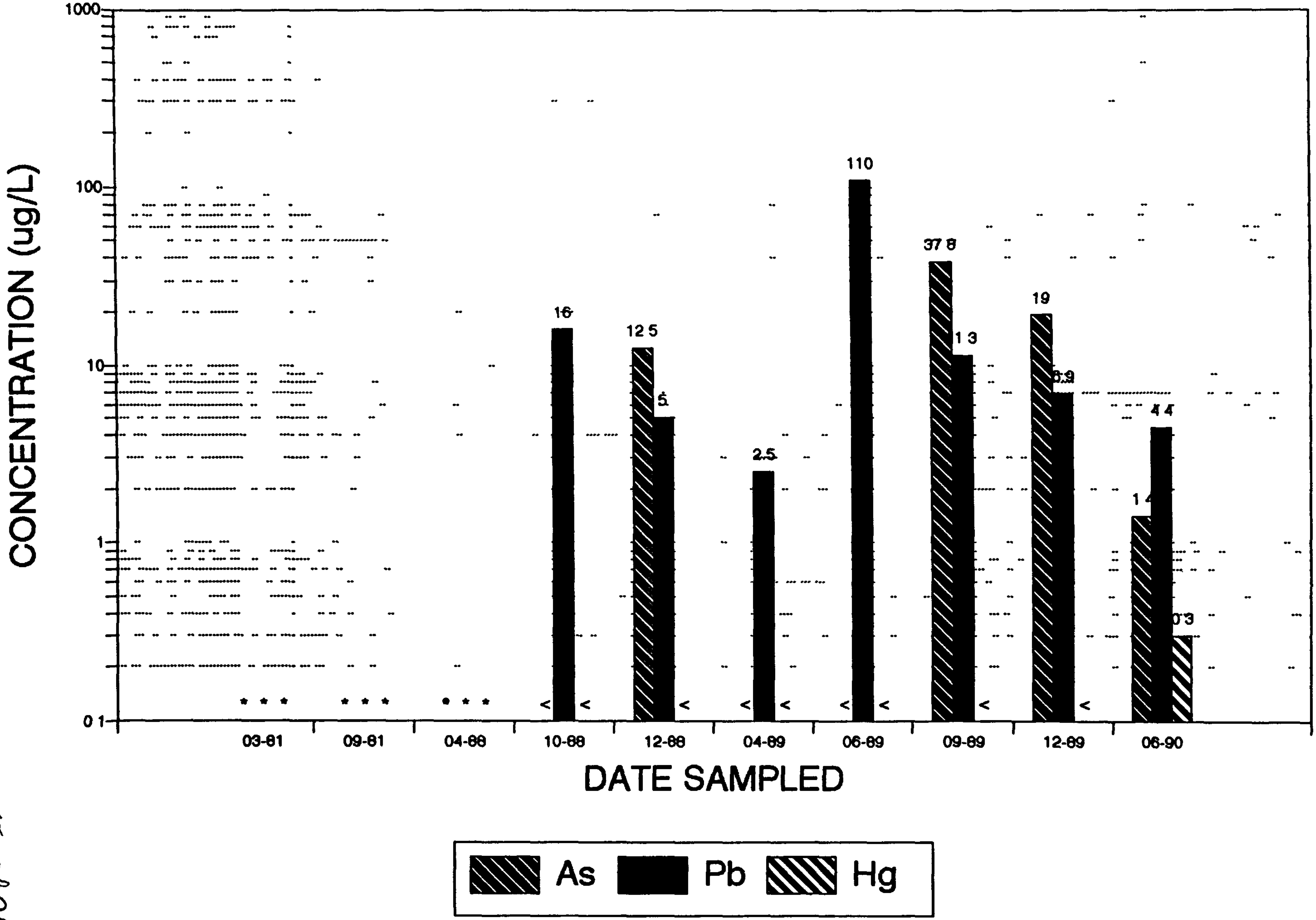

Figure 30- Metals Concentrations at Sample Station FD-371-2- 1988 through 1989

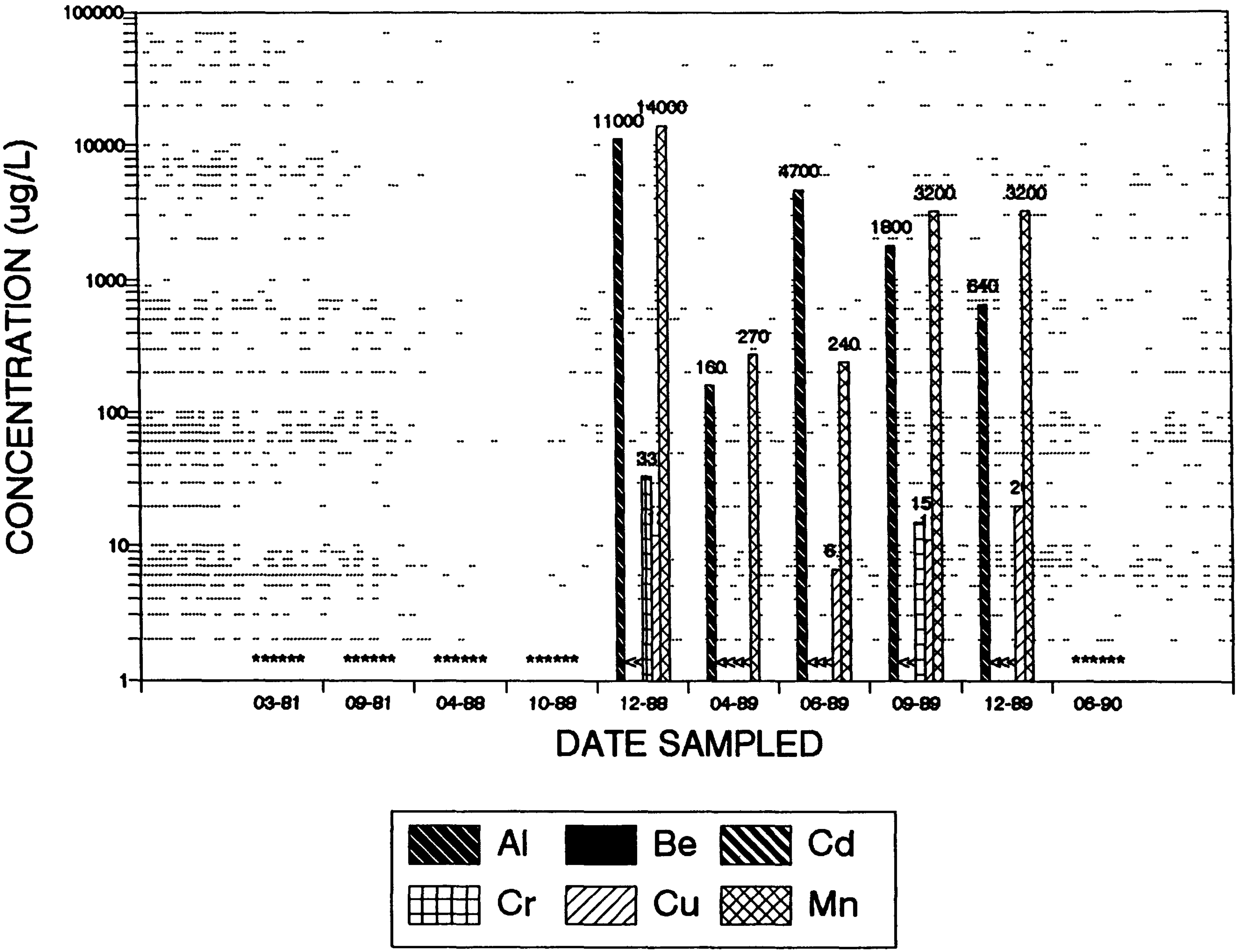

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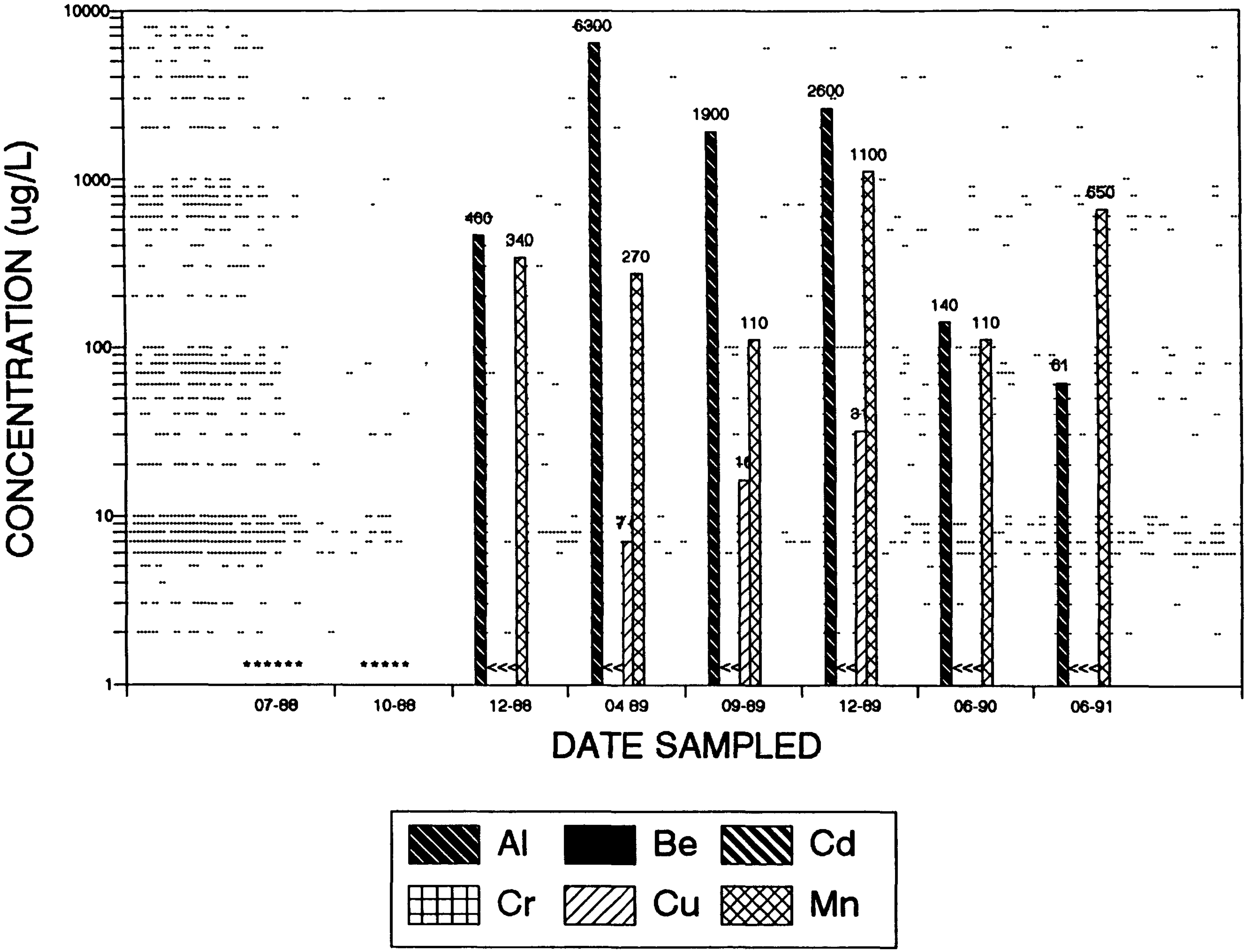
Figure 31- Metals Concentrations at Sample Station FD-371-composite- 1988 through 1991



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4.3.3 Concentration Trends - 400 Area

Gross alpha and gross beta concentrations in samples collected from 1977 through 1980 FD-444-1 and FD-444-2 are presented in Figures 32 and 33. Radionuclide concentrations in foundation drain waters generally decreased during that period. Sample station FD-444-460 exhibited an increase in gross alpha and gross beta concentrations in 1989, followed by decreasing concentrations (Figure 34) Similarly, aluminum, chromium, manganese, and copper exhibited decreasing concentrations at FD-444-460 from 1989 to 1991 (Figure 35)

4.3.4 Concentration Trends - 500 Area

Figure 36 illustrates the changes in gross alpha and gross beta concentrations in samples from station FD-516-1, from 1977 through 1989 Generally, radionuclide concentrations decreased at FD-516-1, although trends were inconsistent

4.3.5 Concentration Trends - 700 Area

Gross alpha concentrations in samples from station FD-707-1 generally decreased from 1977 to 1991 (Figure 37) Gross beta concentrations at FD-707-1 do not show consistent trends from 1980 to 1991 Gross alpha concentrations at station BS-707-2 peaked at 63 pCi/L in 1978, declined to 2 pCi/L by 1980, peaked again at 33 pCi/L in 1981 and declined in the late 1980s (Figure 38). Gross beta concentrations at FD-707-2 were variable from 1980 to 1991. Similarly, gross alpha and gross beta concentrations at BS-707-3 (Figure 39), FD-771-4 (Figure 40), FD-774-1 (Figure 41), FD-771-2 (Figure 42), and FD-779-1 (Figure 43) do not exhibit consistent trends.

Figure 32- Gross Alpha and Gross Beta Concentrations at Sample Station FD-444-1- 1977 - 1980

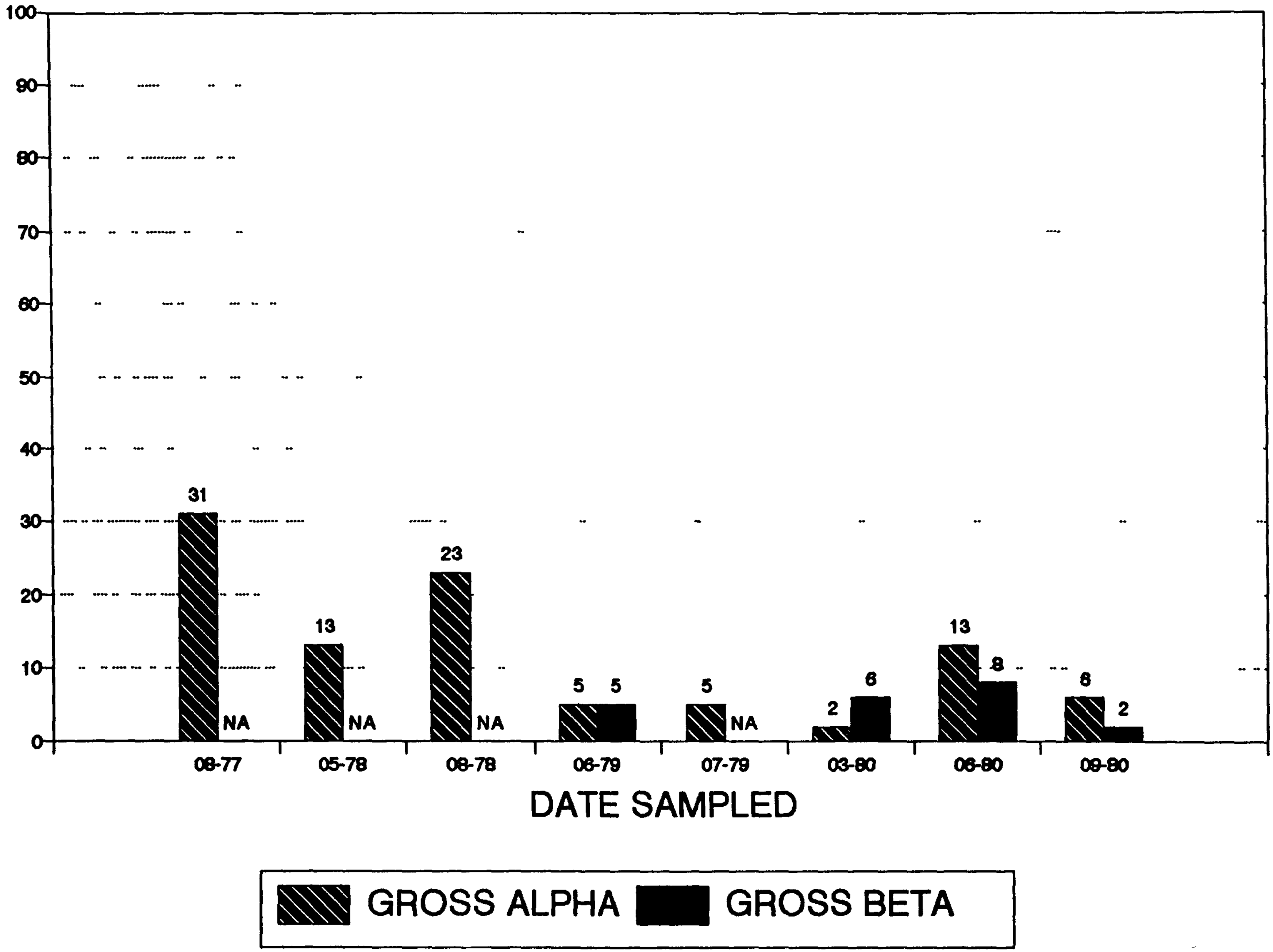

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Figure 33- Gross Alpha and Gross Beta Concentrations at Sample Station FD-444-2- 1977 through 1980

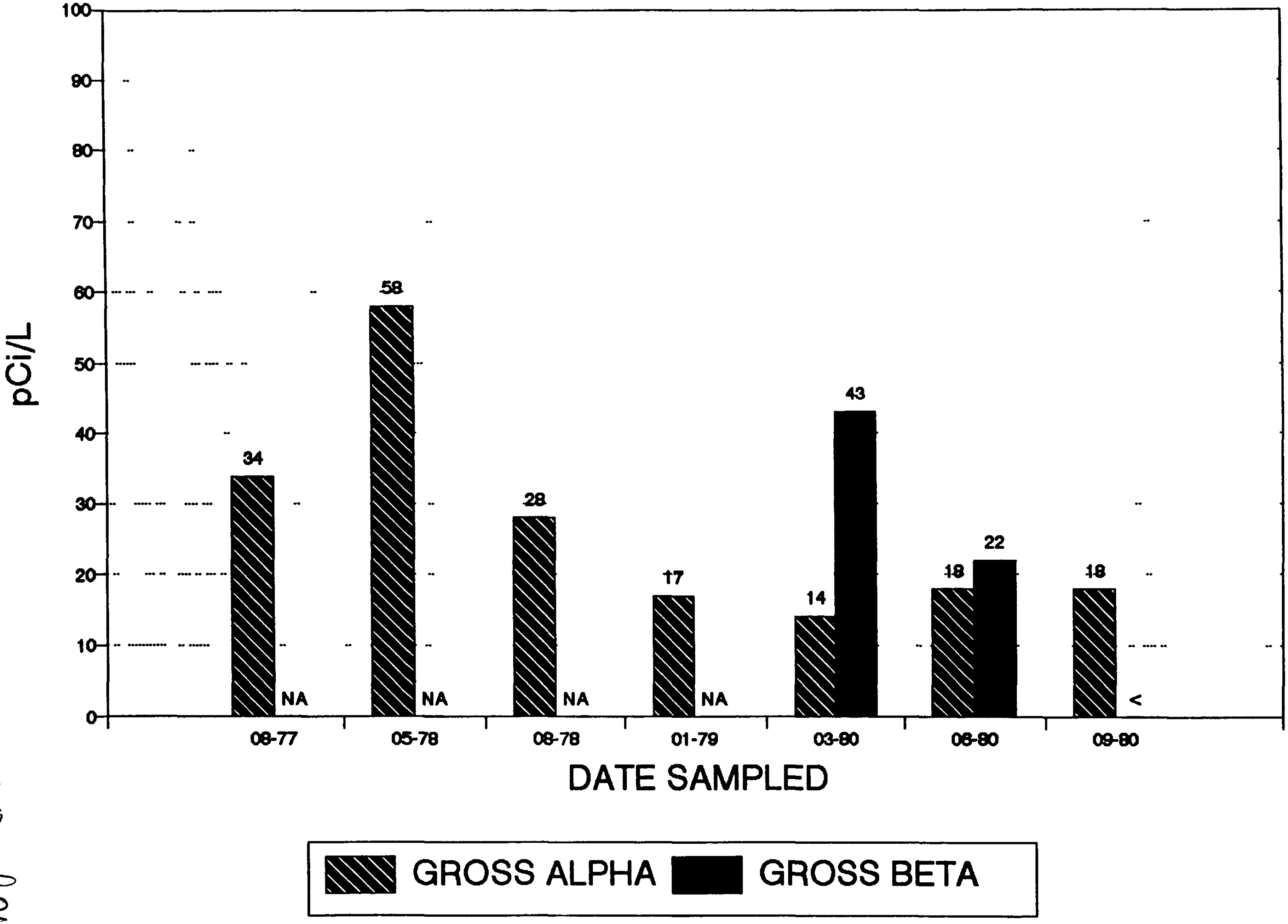

Figure 34- Gross Alpha and Gross Beta Concentrations at Sample Station FD-444-460- 1989 through 1991

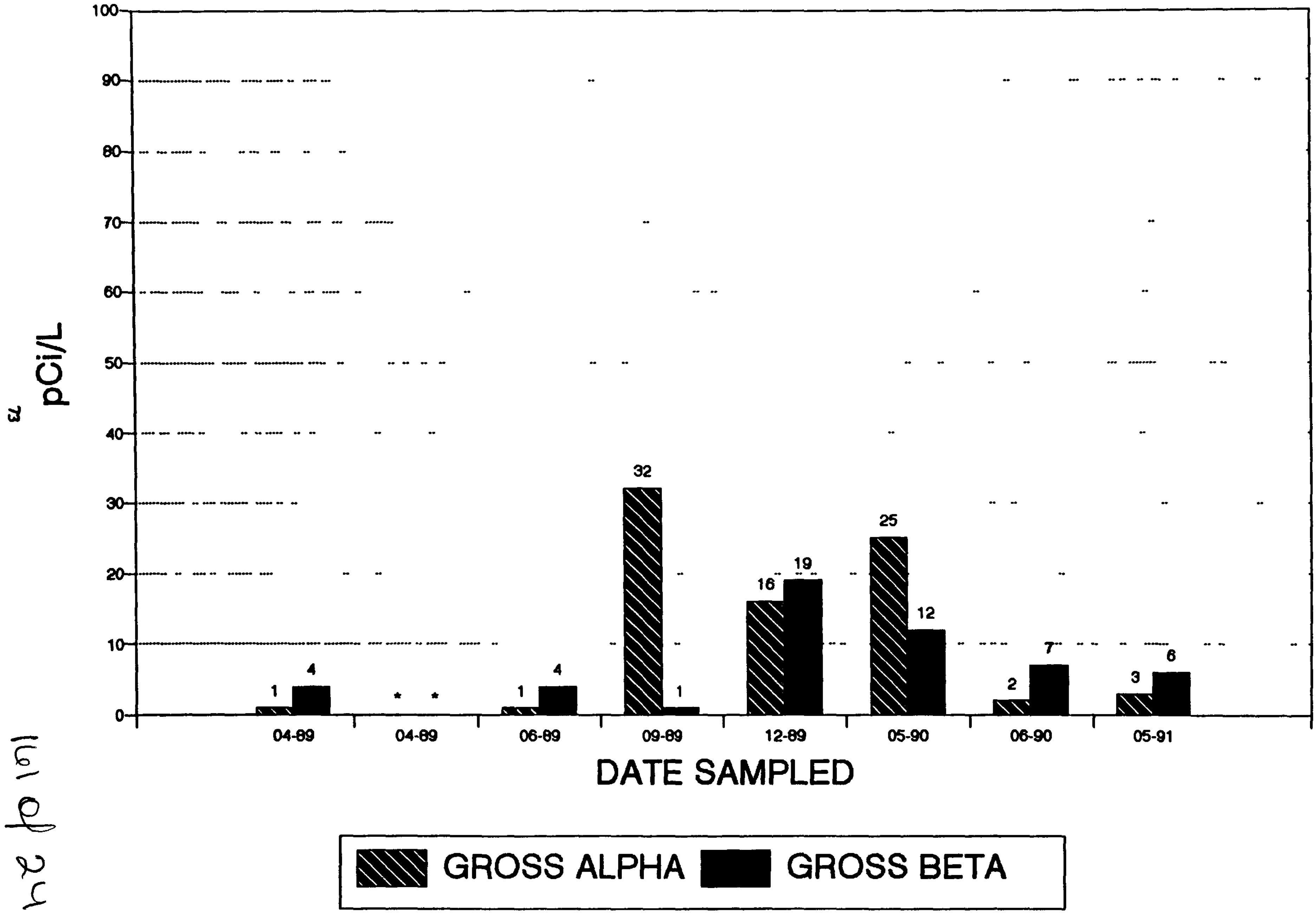

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Figure 35- Metals Concentrations at Sample Station FD-444-460- 1989 through 1991

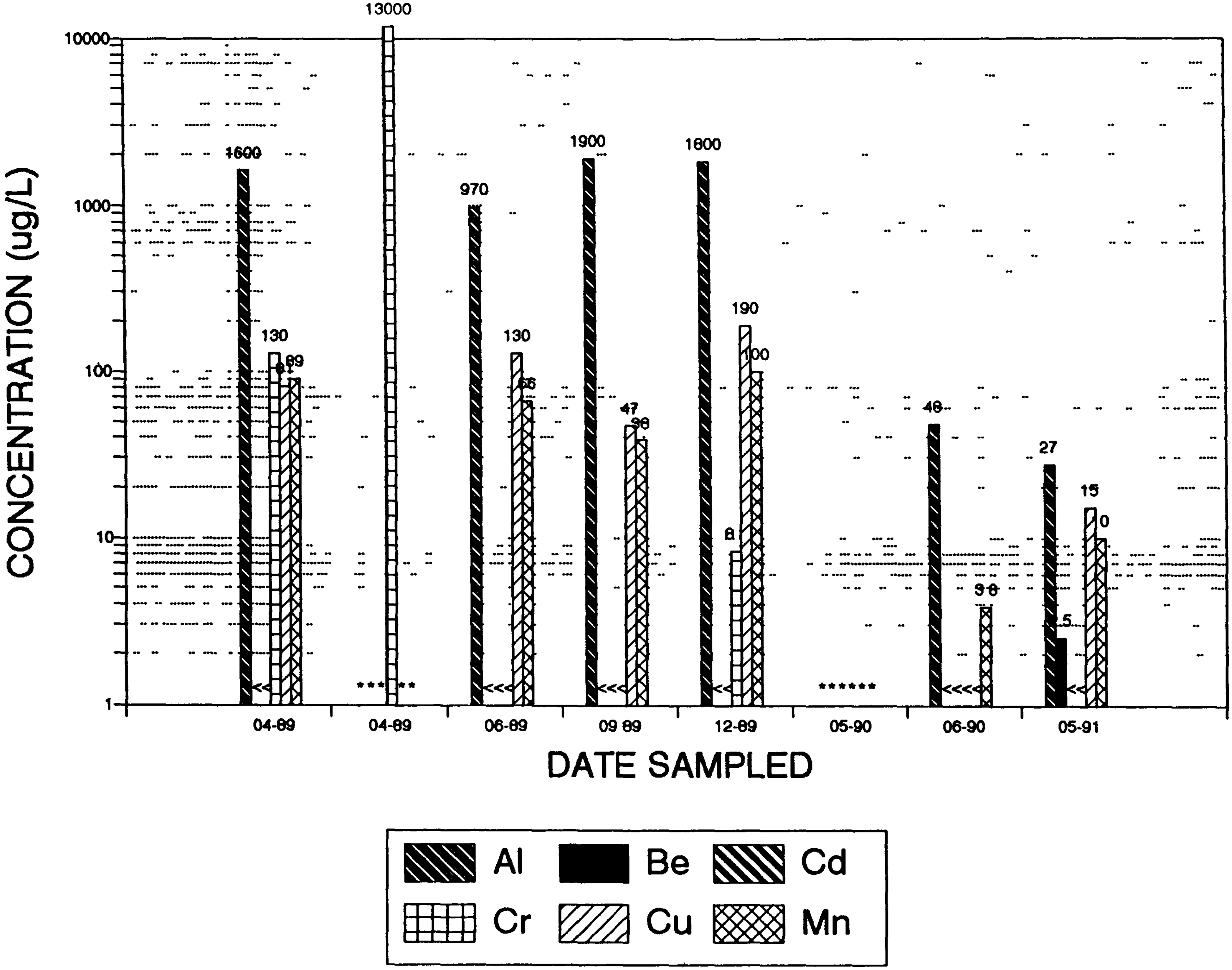

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Figure 36- Gross Alpha and Gross Beta Concentrations at Sample Station FD-516-1- 1977 through 1989

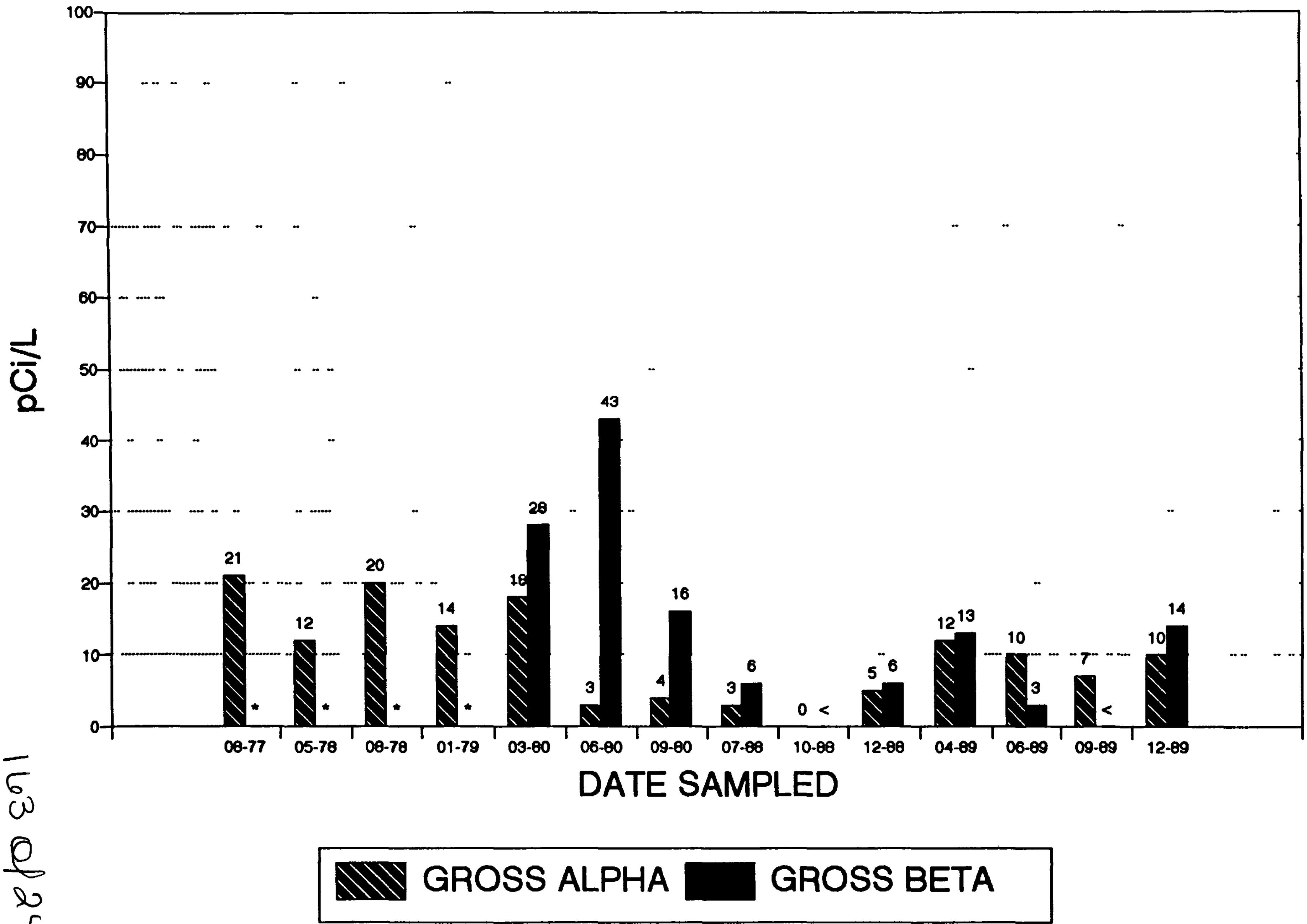

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Figure 37- Gross Alpha and Gross Beta Concentrations at Sample Station FD-707-1- 1977 through 1991

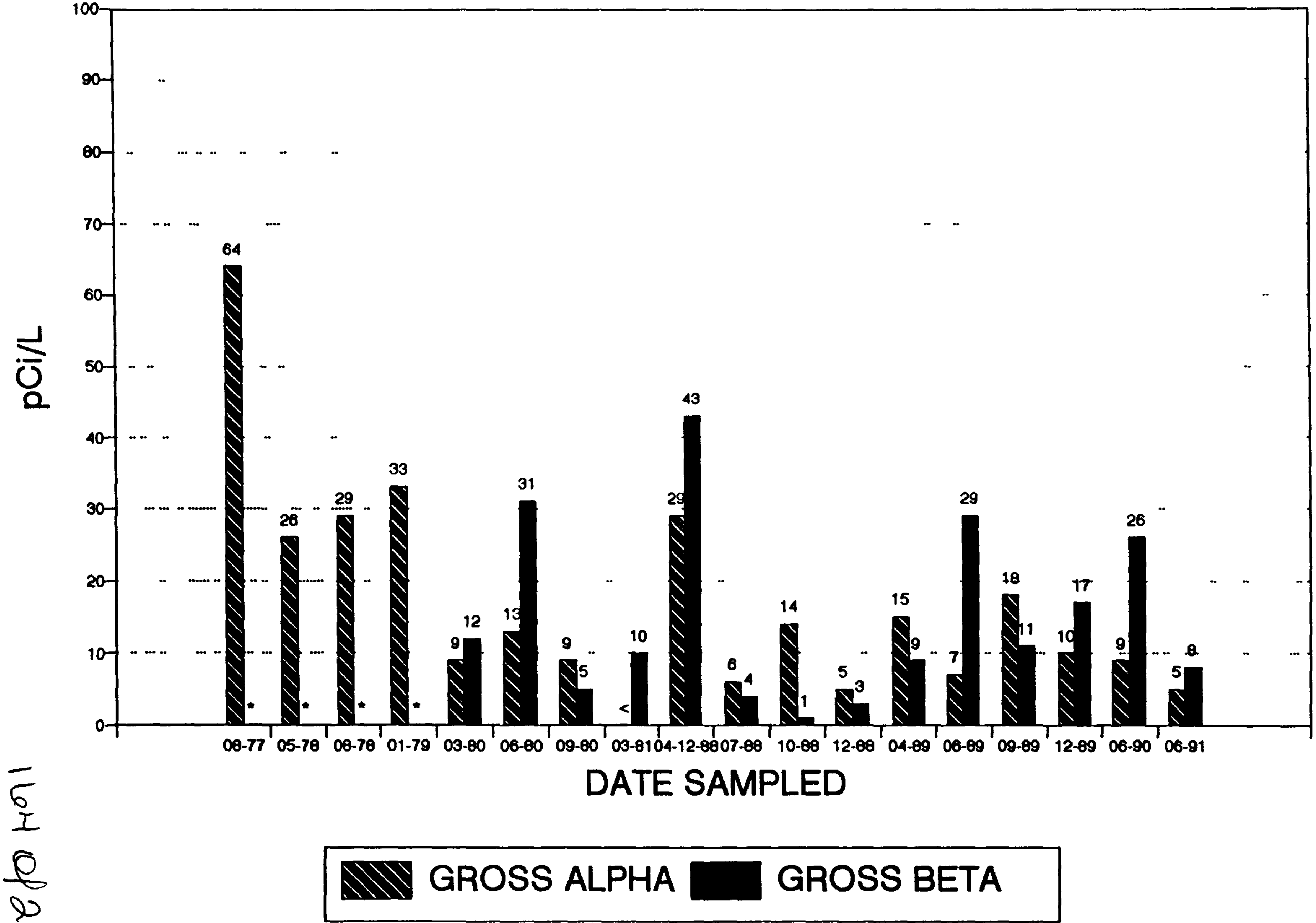

Figure 38- Gross Alpha and Gross Beta Concentrations at Sample Station FD-707-2- 1977 through 1991

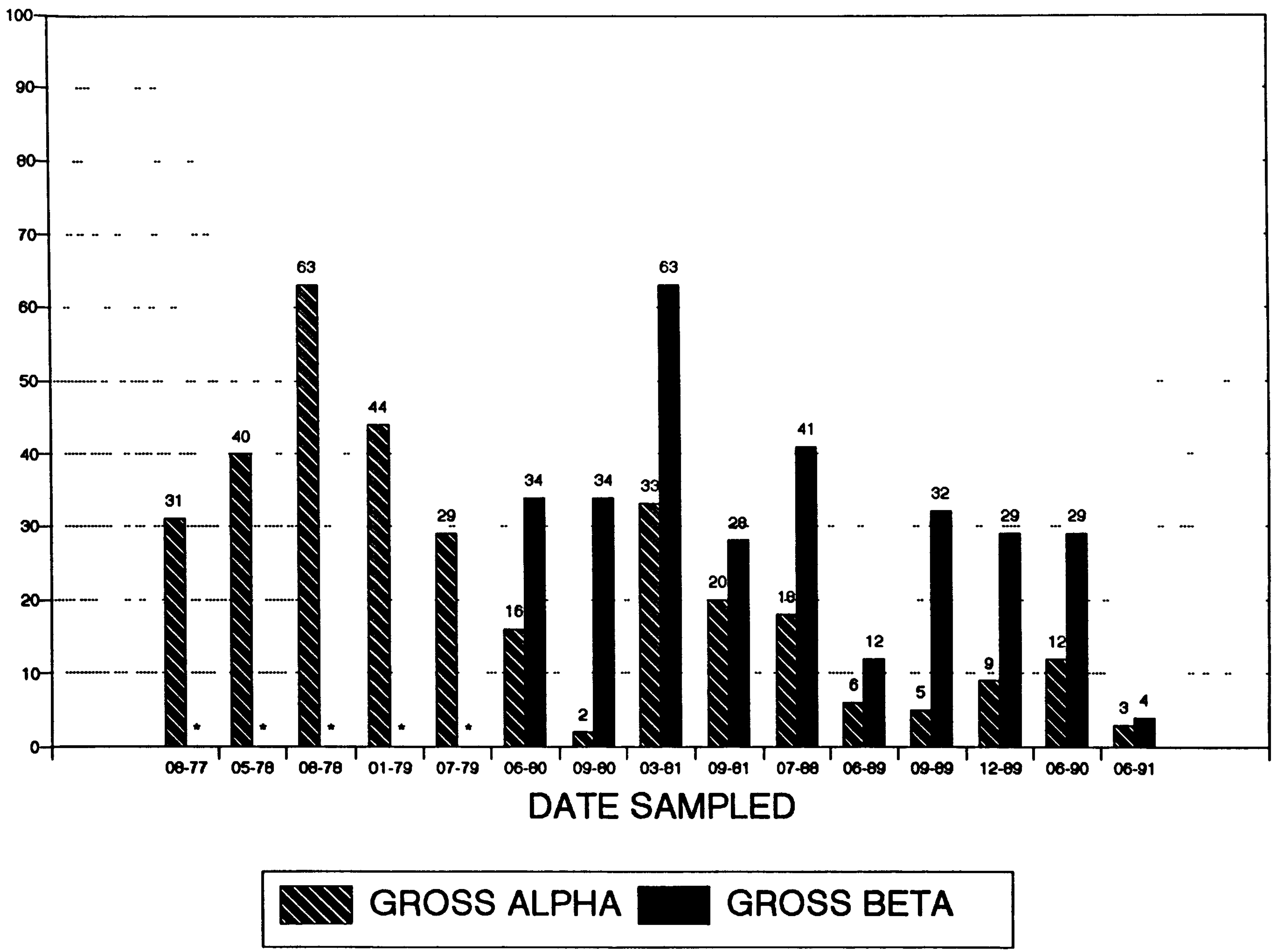

Figure 39- Gross Alpha and Gross Beta Concentrations at Sample Station BS-707-3- 1980 through 1989

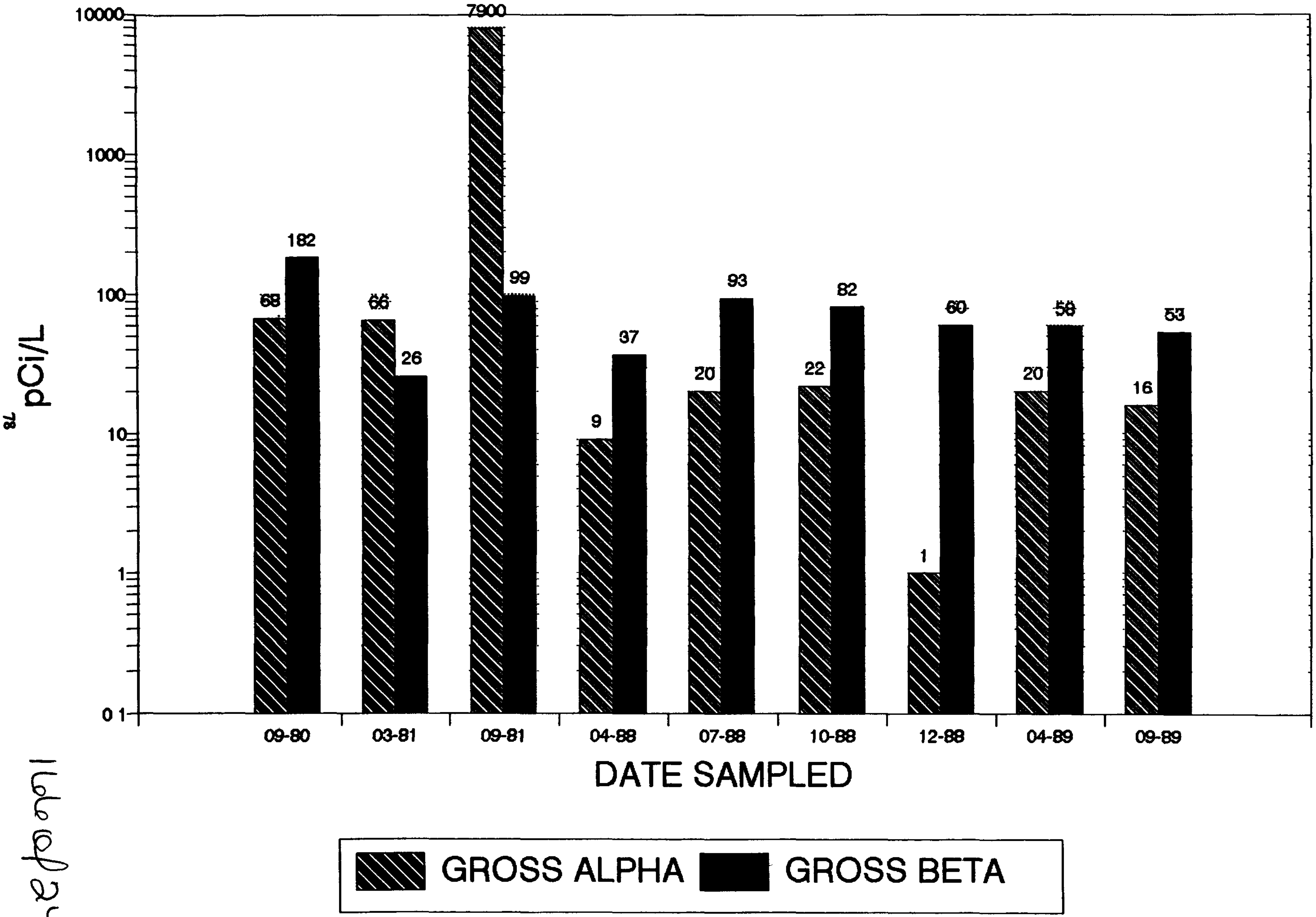

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Figure 40- Gross Alpha and Gross Beta Concentrations at Sample Station FD-771-4- 1977 through 1980

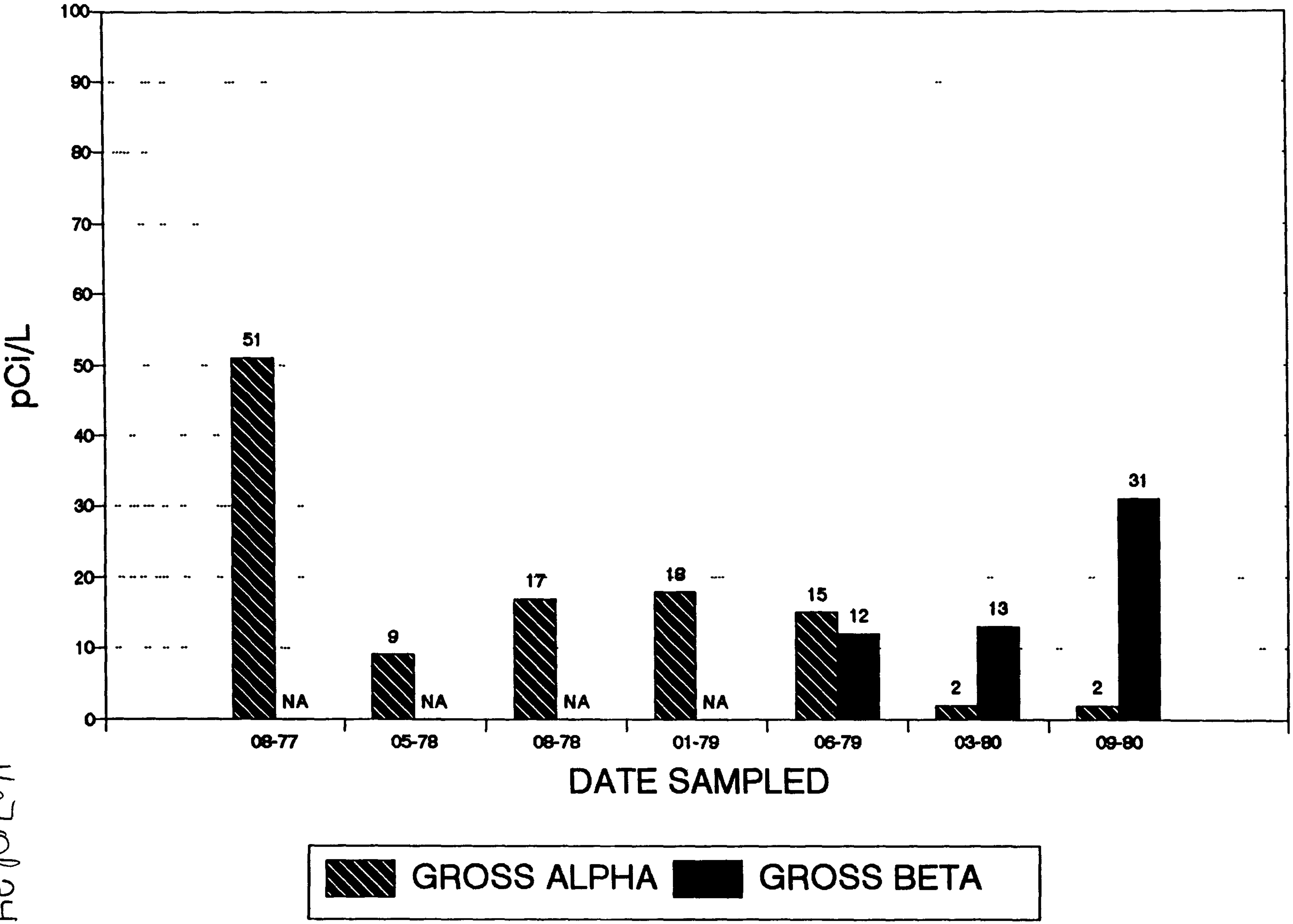

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Figure 41- Gross Alpha and Gross Beta Concentrations at Sample Station FD-774-1- 1980 through 1989

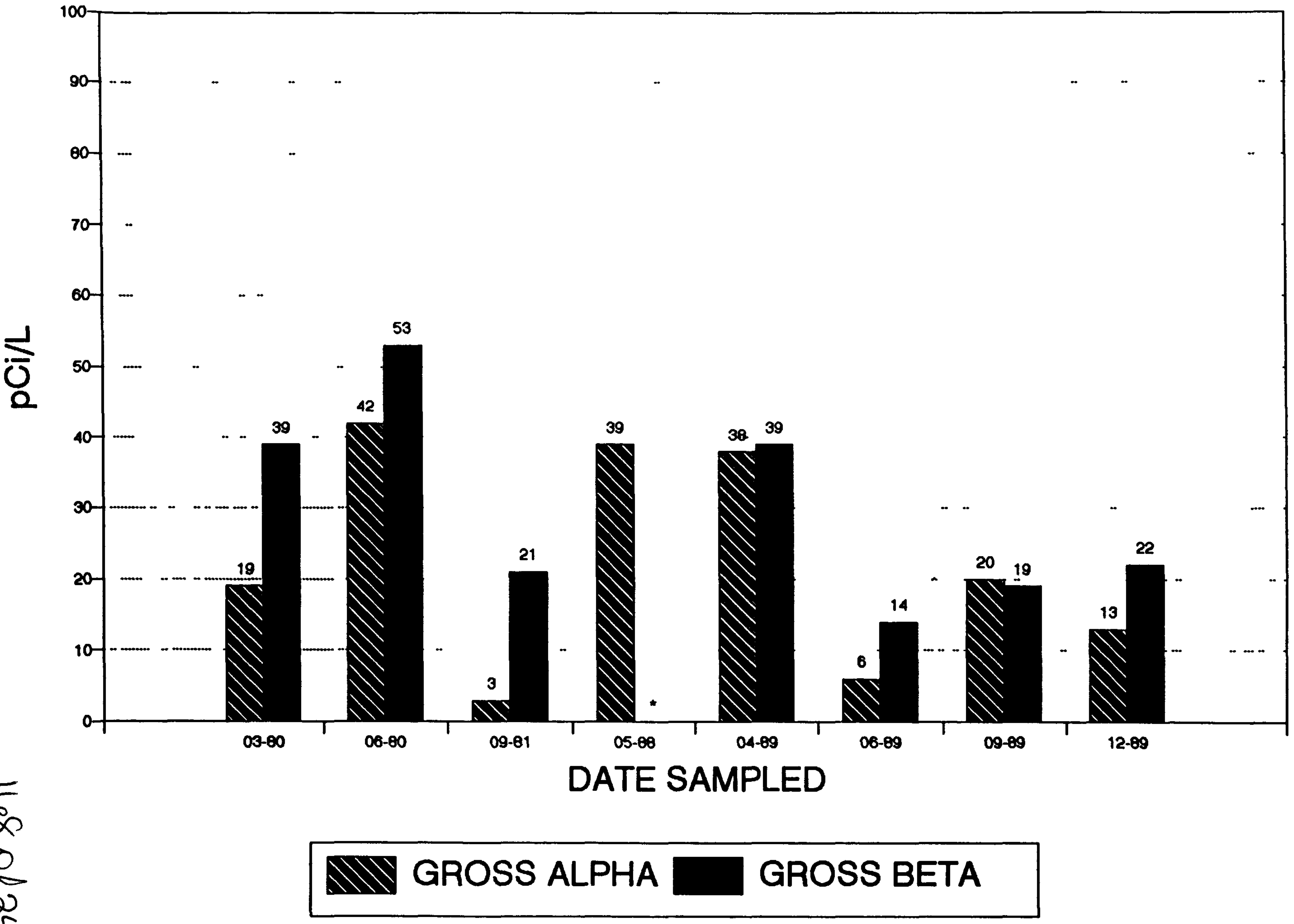


Figure 42- Gross Alpha and Gross Beta Concentrations at Sample Station FD-771-2- 1977 through 1980

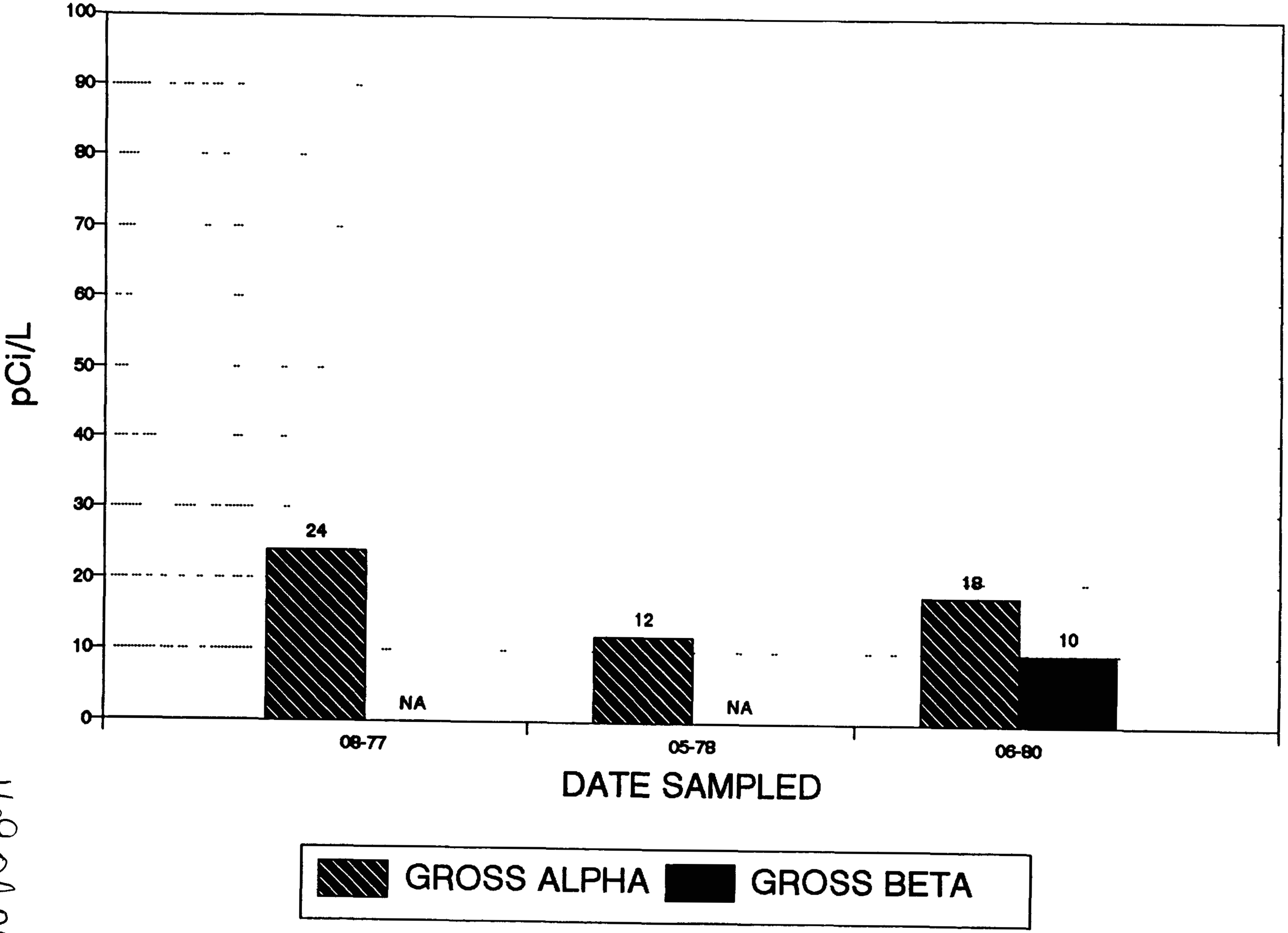
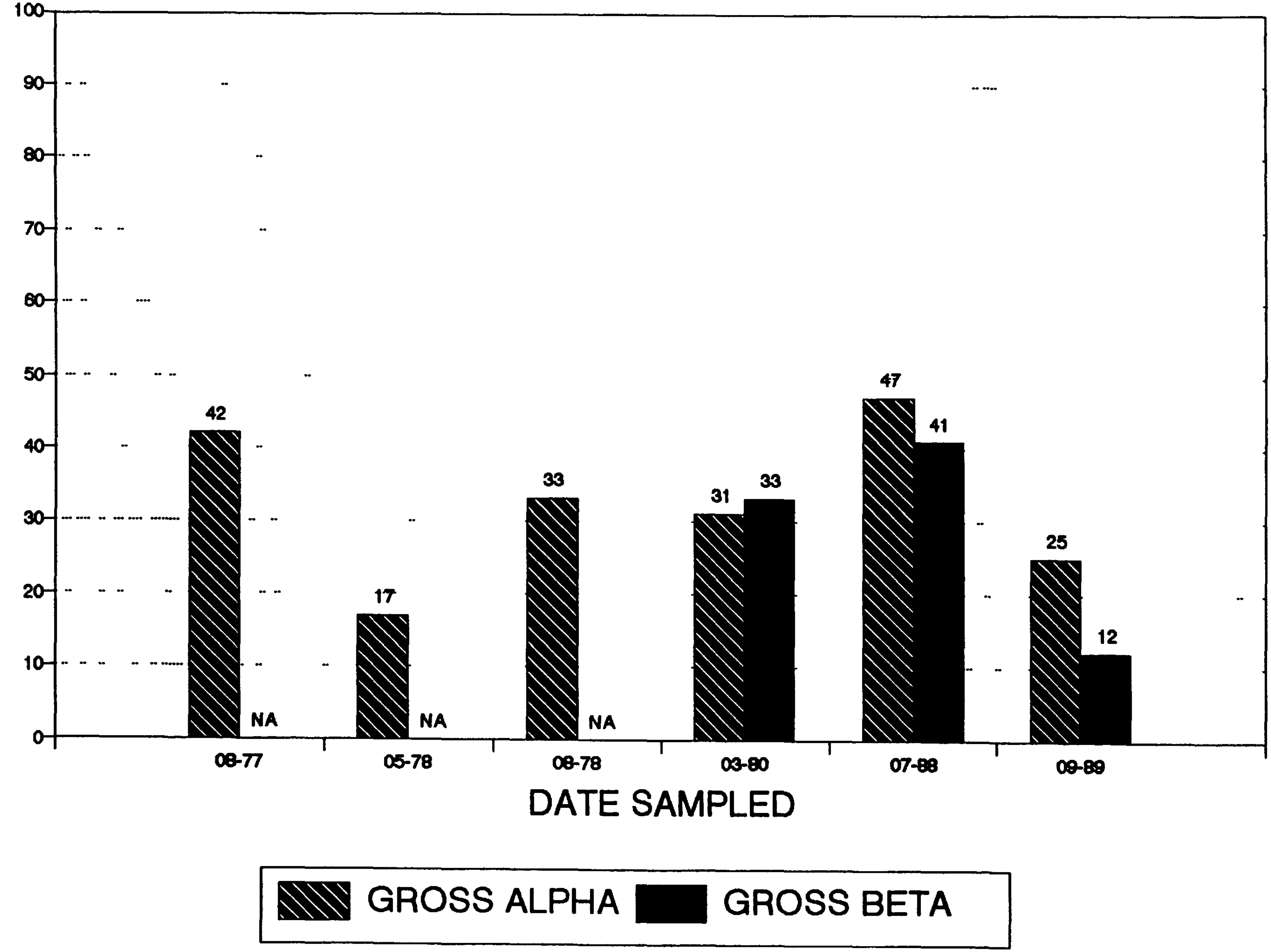


Figure 43- Gross Alpha and Gross Beta Concentrations at Sample Station FD-779-1- 1977 through 1989



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Metals concentrations varied over time, but decreases in aluminum, manganese, and copper are observed from December 1989 to June 1991. The concentrations of selected metals at FD-707-1 are presented in Figure 44. Similar trends were observed for aluminum at station BS-707-2 (Figures 45 and 46).

4.3.6 Concentration Trends - 800 Area

Gross alpha and gross beta concentrations in samples from station FD-881-1 exhibit variable trends, but the concentration generally decreased from 1977 to 1991 (Figure 47) Gross alpha concentrations at station BS-881-3 from 1977 through 1990 ranged from five to 22 pCi/L, with the exception of peaks in 1979 (48 pCi/L) and 1980 (33 pCi/L) (Figure 48). Gross beta concentrations from that period ranged from 1 to 17 pCi/L, with the exception of a peak concentration of 31 pCi/L in 1988 Gross alpha and gross beta concentrations at station BS-883-1 peaked in 1981 and varied around means of 14 pCi/L (gross alpha) and 9 pCi/L (gross beta) in the decade following (Figure 49).

Metals concentrations at FD-881-1 (Figure 50), BS-881-3 (Figure 51), and BS-883-1 (Figure 52) did not exhibit consistent trends during the 1988 to 1991 period.

4.4 SAMPLING RECOMMENDATIONS

Because the 24-hour CCTV video tape of the storm sewer system for the entire plant was unavailable for review before the completion of this Draft Technical Memorandum, the following recommendations are considered preliminary and are subject to change after the storm sewer video information is evaluated. To fulfill the objectives of the OU8 Work Plan, recommendations for the optimum sampling locations for foundation drains are made. Additional surface water and sediment sampling may be required within the storm and/or

Figure 44- Metals Concentrations at Sample Station FD-707-1- 1988 through 1991

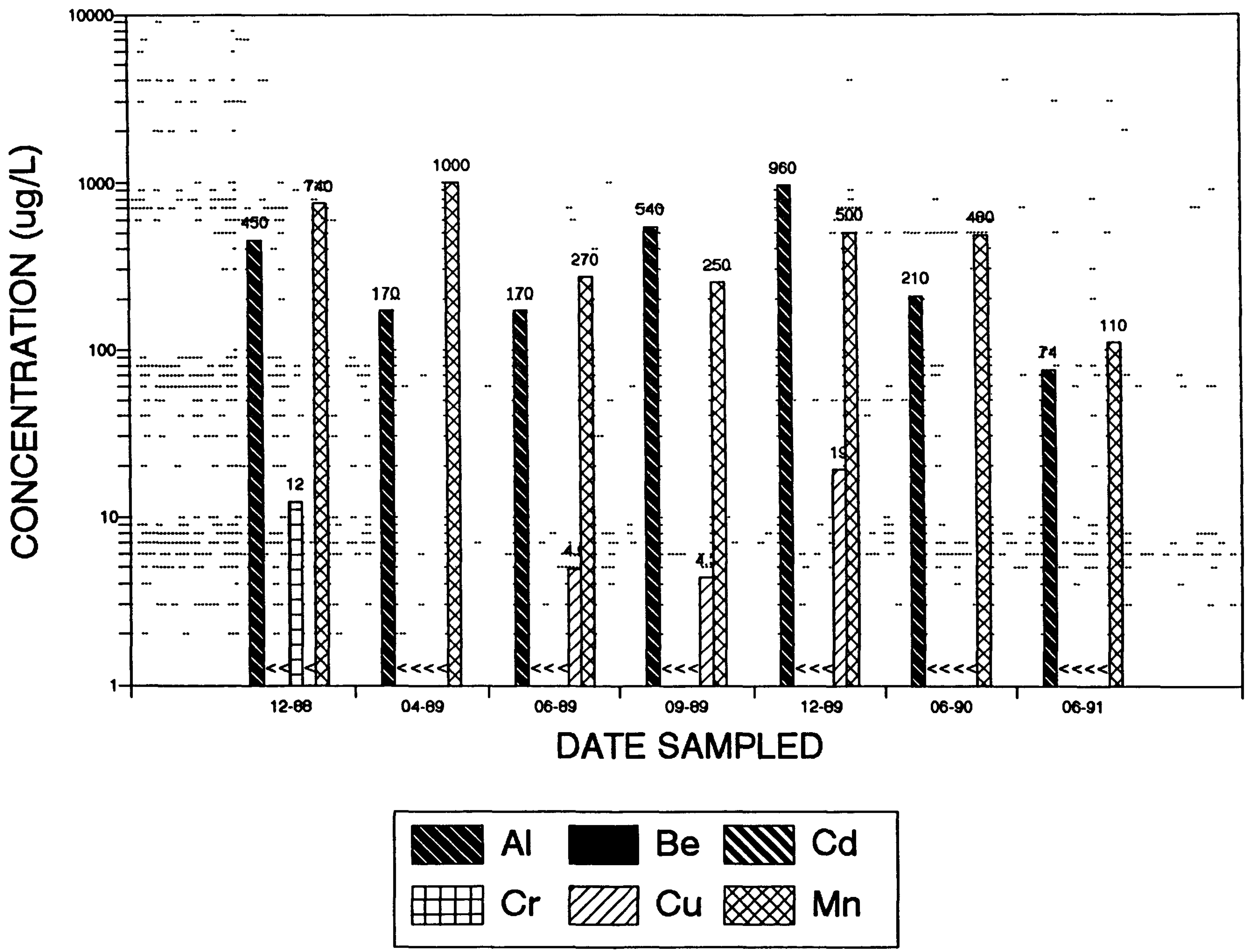

Figure 45- Metals Concentrations at Sample Station BS-707-2- 1988 through 1991

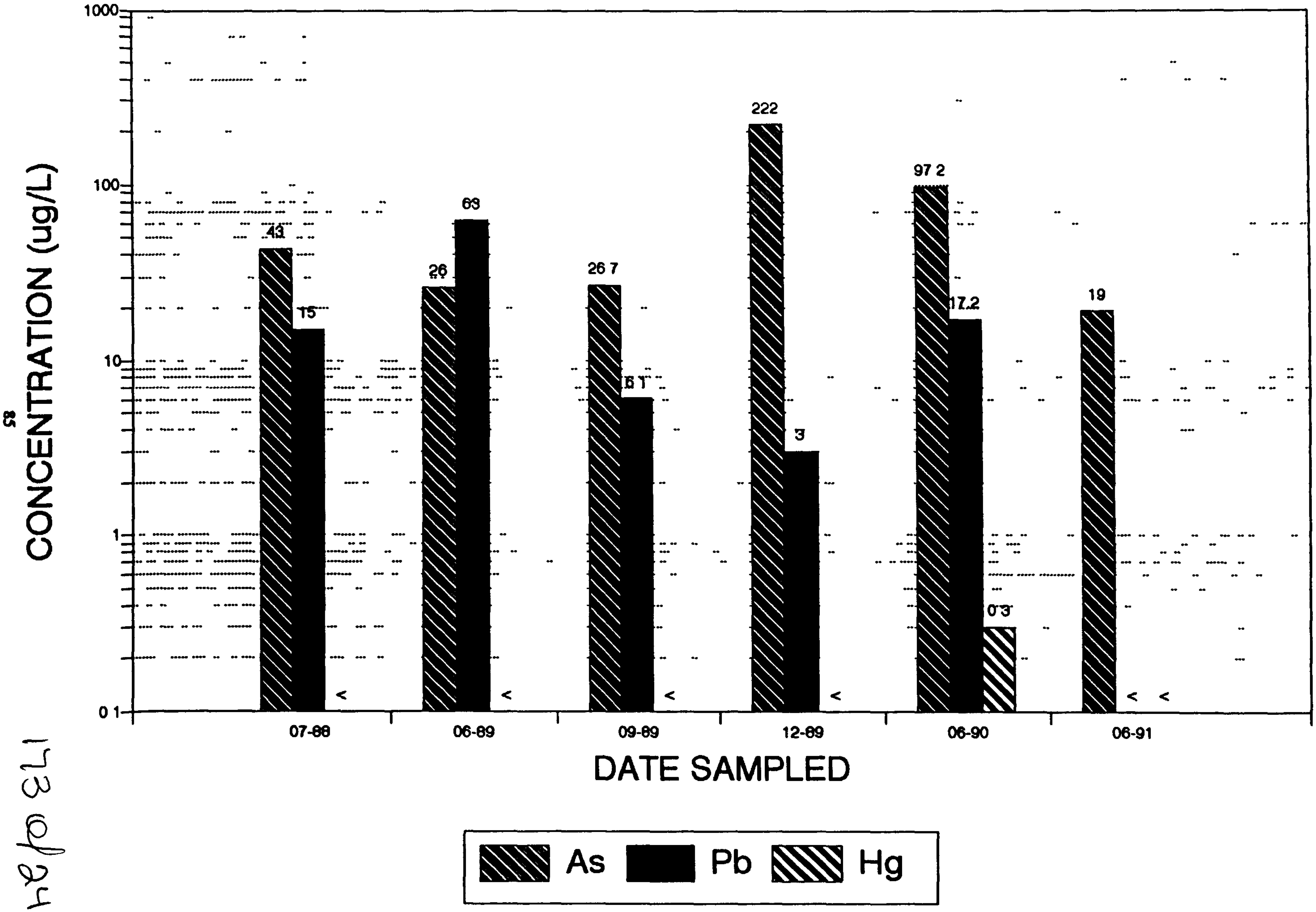

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Figure 46- Metals Concentrations at Sample Station BS-707-2- 1989 through 1991

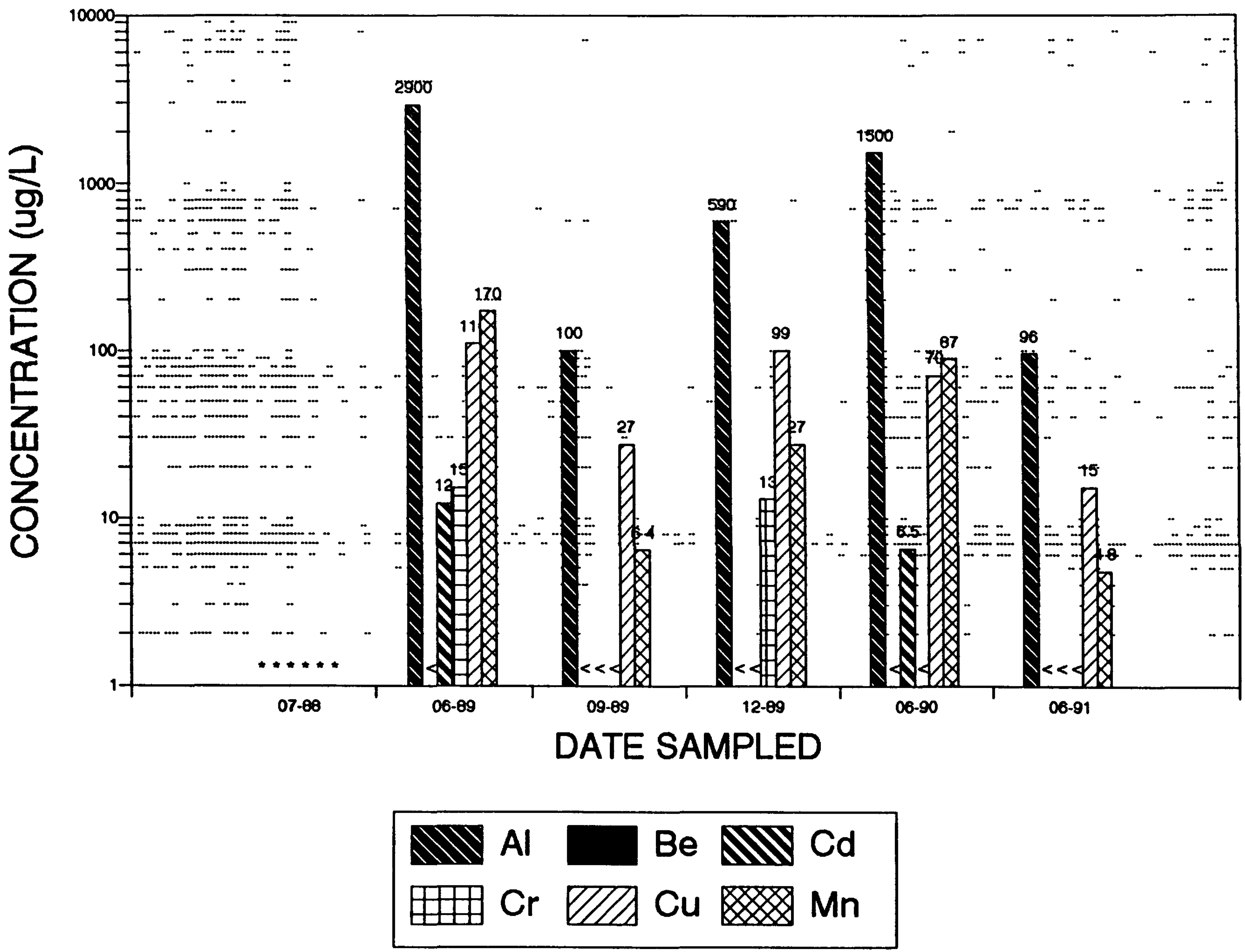

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Figure 47- Gross Alpha and Gross Beta Concentrations at Sample Station FD-881-1- 1977 through 1991

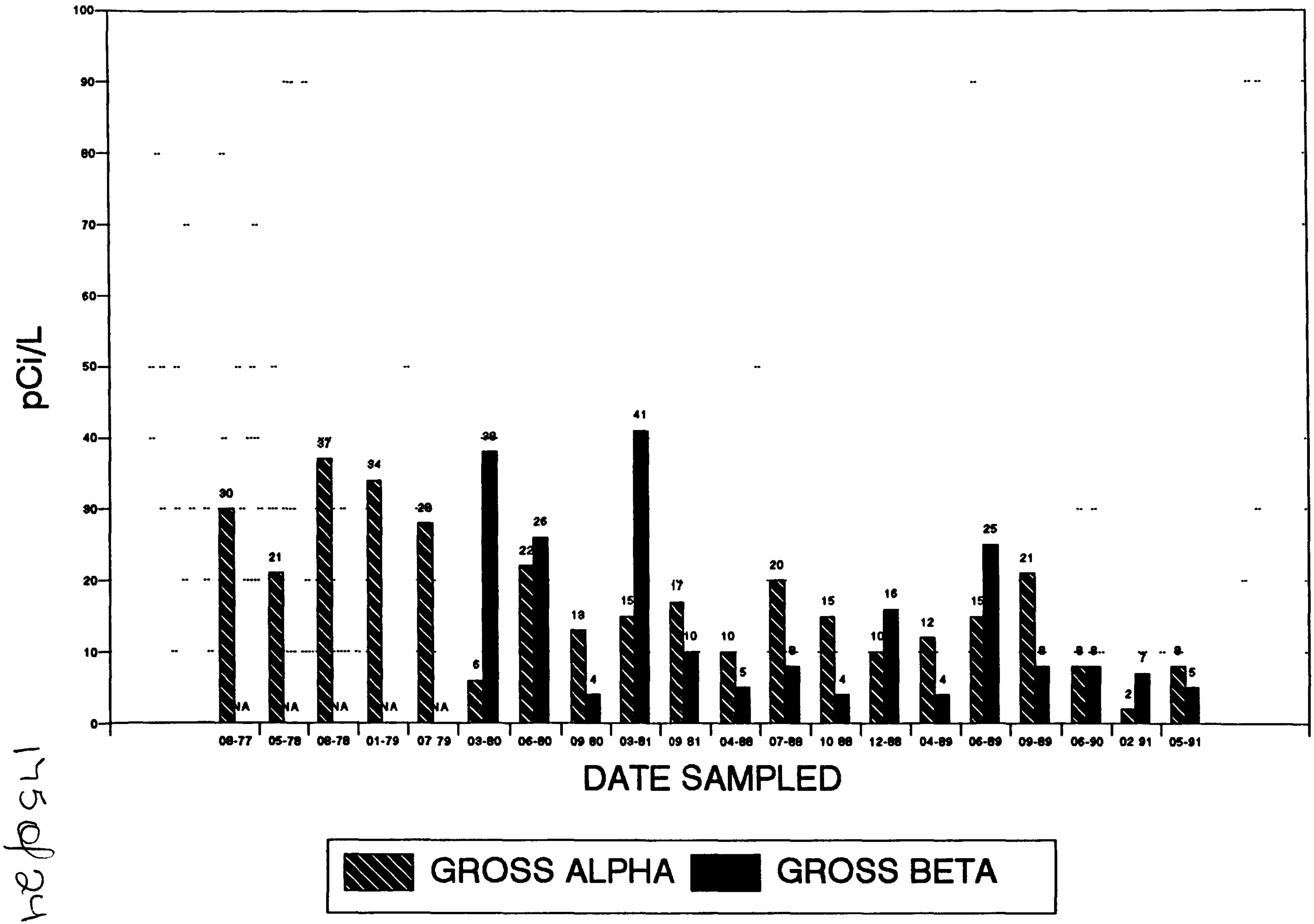

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Figure 48- Gross Alpha and Gross Beta Concentrations at Sample Station FD-881-3- 1977 through 1990

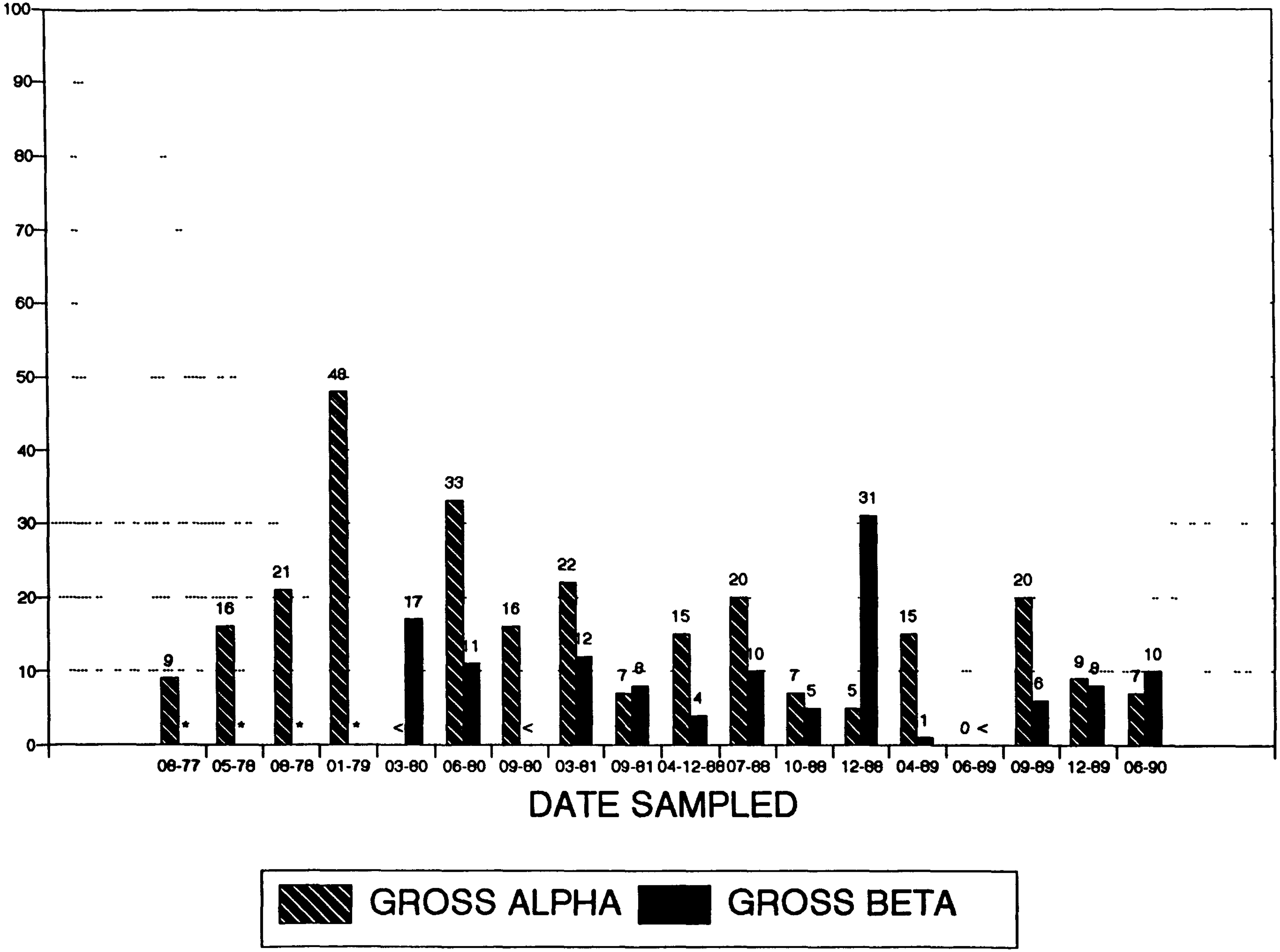

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Figure 49- Gross Alpha and Gross Beta Concentrations at Sample Station FD-883-1-
1977 through 1991

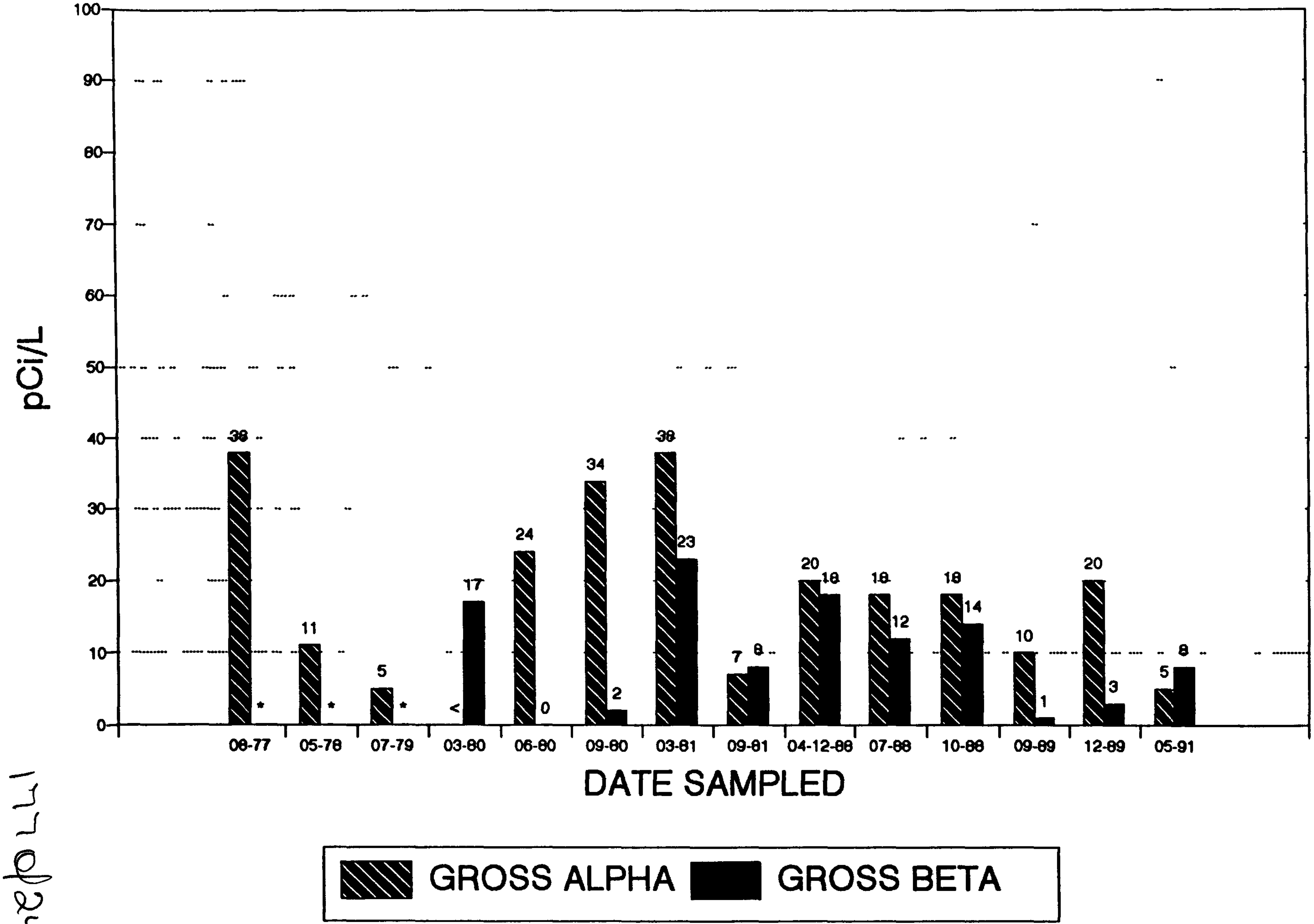

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Figure 50- Metals Concentrations at Sample Station FD-881-1- 1988 through 1991

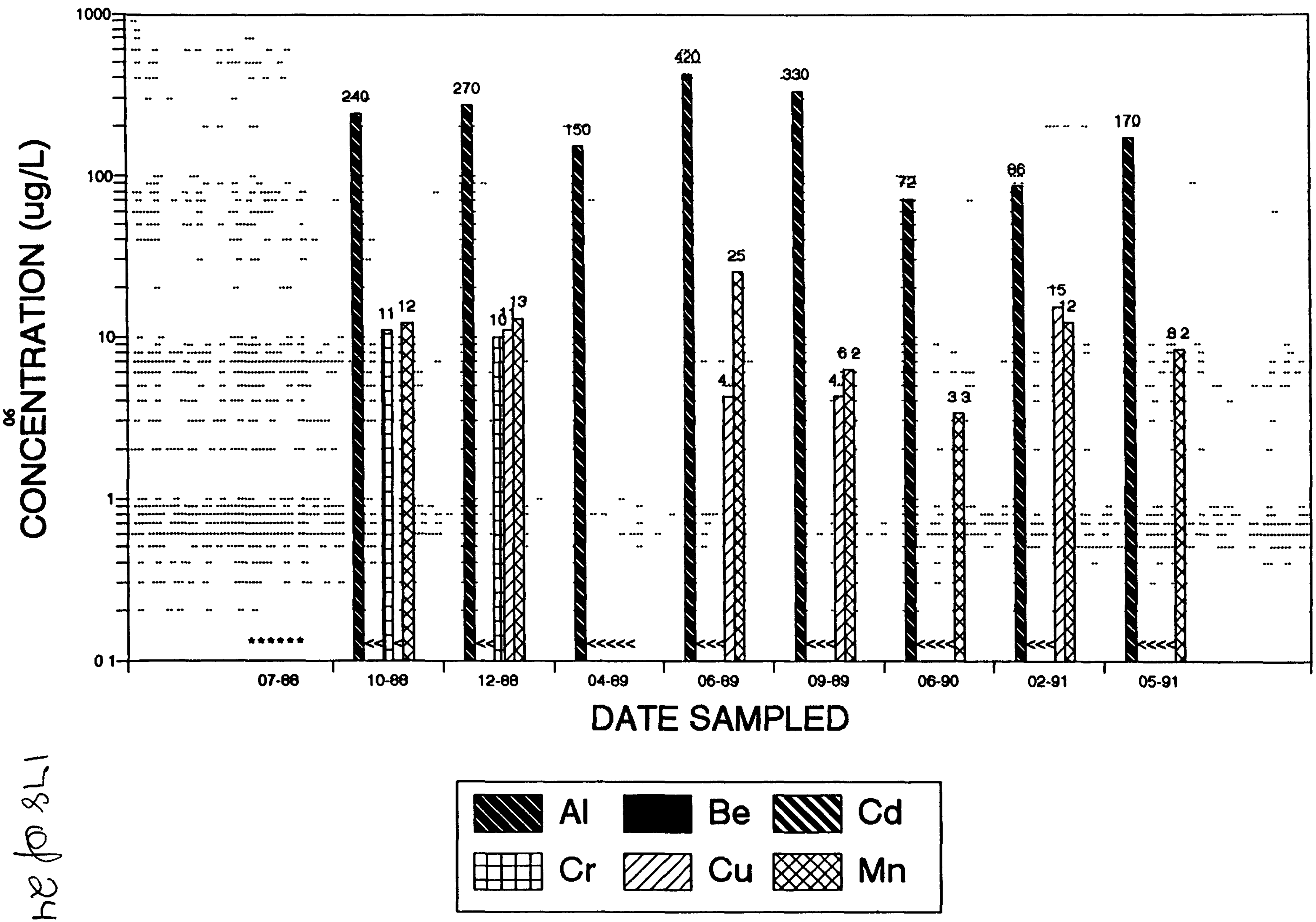

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Figure 51- Metals Concentrations at Sample Station BS-881-3- 1988 through 1990

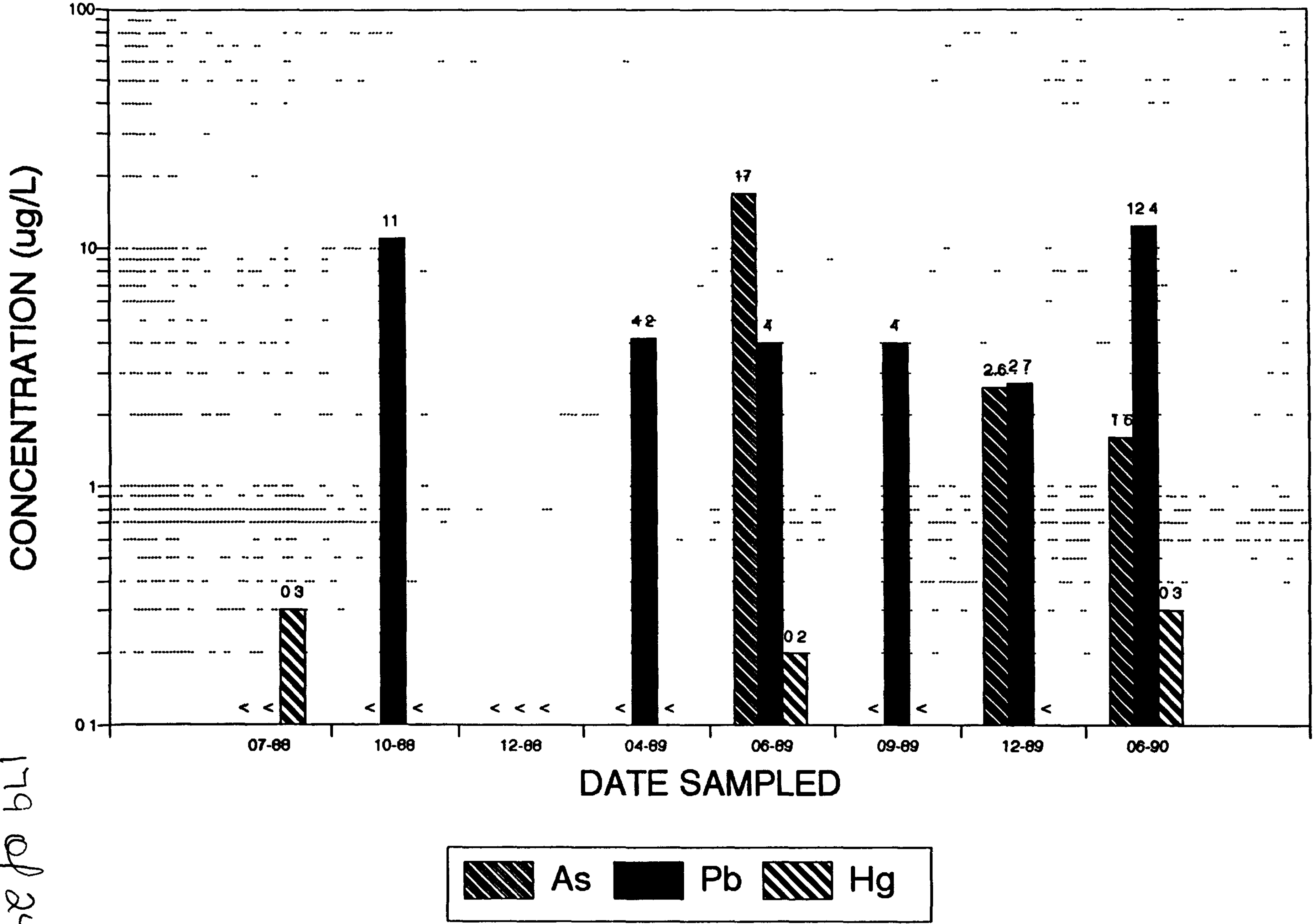

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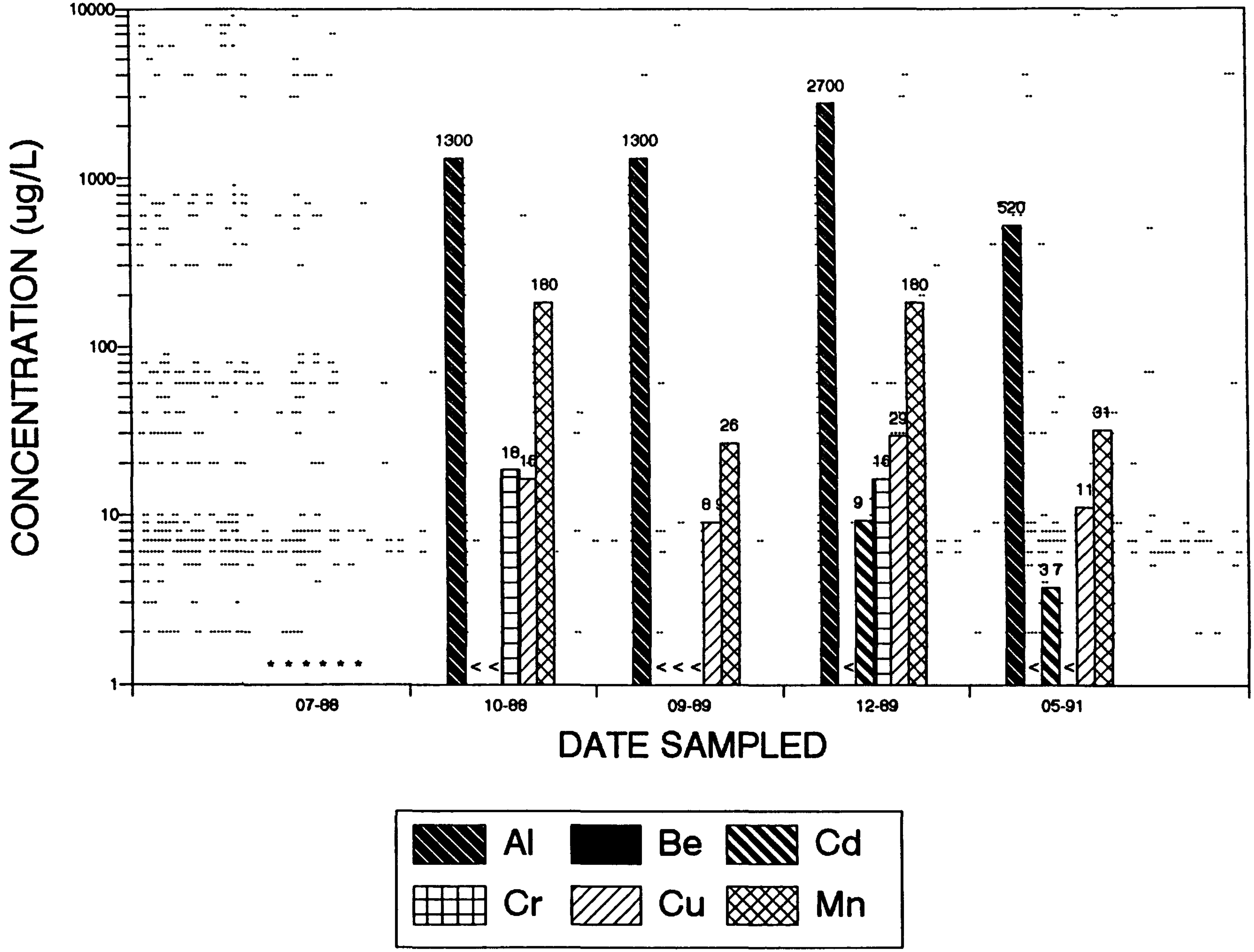
Figure 52- Metals Concentrations at Sample Station BS-883-1- 1988 through 1991



sanitary sewer systems to reliably isolate a given OU8 IHSS as a source. Therefore, recommendations are made both for updating the current foundation drain sampling program and for sampling as part of Stage 2 OU8 RFI/RI activities. These recommendations are summarized in the following sections and in Table 11

Building 111 SWD currently samples a sump (BS-111-2) in the basement of the building This sump is probably not connected to the foundation drains. The foundation drain outfall, located to the north of Building 111 and west of Building 115 (Figure 5), could not be located during the site reconnaissance Based on an evaluation of the analytical data, no further sampling of this building is recommended

Building 124 The foundation drains for this building have not been sampled historically. It is recommended that the sump located east of the building be sampled once for the comprehensive analyte list (Table 12) An evaluation of the analytical results from this sampling will determine whether sampling should continue and how frequently

Buildings 371/374 EG&G SWD should continue to sample FD-371-3. Outfall FD-371-2 should be sampled if sufficient flow is observed. (Based on field observations, FD-371-2 will likely discharge sufficient water for sampling.) Sediment samples should be collected at both FD-371-2 and FD-371-3 for OU8 investigations. FD-371-MC (metal culvert) collects steam condensate near Building 371/374 and should be removed from the sampling program.

Table 11 - Summary of Recommended Foundation Drain Sampling

BUILDING	CURRENT SAMPLING STATION	SWD SAMPLING MODIFICATION	OU8 RECOMMENDED SAMPLING	OU8 ANALYTICAL*
111	BS-111-2	Not a foundation drain	No sampling recommended	None
124	None	No change	Sample sump east of building	VOCs, SVOCs, Metals, Rads
371/374	FD-371-3	No change; continue to sample FD-371-3	Sample FD-371-2 if flow is observed. Collect sediment samples at FD-371-2 and FD-371-3	Water - VOCs, SVOCs, Metals, Rads Sediment- SVOCs, Rads
	FD-371-MC	Delete from program; currently sampling steam condensate	No sampling recommended	None
444/447	FD-444-460	Continue to Sample FD-44-460 for 4 quarters, add sample location FD-447-1	No sampling recommended	None
559	None	No change	Collect sediment sample from FD-516-1	SVOCs, Rads
707	FD-707-2	Collect samples at new location FD-707-4	No sampling recommended	None
771	FD-771-1	Collect Samples at new location FD-771-4	No sampling recommended	None

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BUILDING	CURRENT SAMPLING STATION	SWD SAMPLING MODIFICATION	OU8 RECOMMENDED SAMPLING	OU8 ANALYTICAL*
774	FD-774-1 FD-774-2	No change	Collect sediment samples at outfalls FD-774-1 and FD 774-2	SVOCs, Rads
779	FD-779-1	Collect sample at new location FD-779-2	No sampling recommended	None
850	None	No change	No sampling recommended	None
865	BS-865-1 BS-865-2	Delete FD-865-1, continue to sample FD-865-2	No sampling recommended	None
886	None	No change	No sampling recommended	None
881	None	None	Sample FD-881-4, once	VOCs, SVOCs, Metals, Rads
883	FD-883-1	Delete From Program	No sampling recommended	None
991/998	BS-991-2	None	No sampling recommended	None
995	None	None	No sampling recommended	None
996/997/999	None	None	No sampling recommended	None

Notes:
SVOCs = Semi-Volatile Organic Compounds
VOCs = Volatile Organic Compounds
Rads = Radionuclide isotopes
* Refer to Table 12 for full list of recommended analytical parameters.
SWD = EG&G Surface Water Division

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Table 12 - Recommended Comprehensive Analyte List Foundation Drain Monitoring

Metals	1,1,2,2,-Tetrachloroethane	4-Nitrophenol
	1,2-Dichloropropane	Acenaphthene
Lithium	trans-1,3-Dichloropropene	Acenaphthylene
Aluminum	Trichloroethene	Anthracene
Antimony	Dibromochloromethane	Benzoic Acid
Arsenic	1,1,2-Trichloroethane	Beno(a)Anthracene
Barium	Benzene	Benzo(a)Pyrene
Beryllium	cis-1,3-Dichloropropene	Benzo(b)Fluoranthene
Cadmium	Bromoform	Benzo(g,h,i)perylene
Calcium	2-Hexanone	Benzo(k)Fluoranthene
Chromium	4-Mehthyl-2-pentanone	Benzyl Alcohol
Cobalt	Tetrachlorethene	Bis(2-Chloroethoxy)Methane
Iron	Toluene	Bis(2-Chloroisopropyl)Ether
Lead	Chlorobenzene	Bis(2-Ethylhexyl)Phthalate
Magnesium	Ethyl Benzene	Butyl Benzyl Phthalate
Manganese	Styrene	Chrysene
Mercury	Total Xylenes	Dibenzofuran
Nickel		Dibenzo(a,h)Anthracene
Potassium	**Semi-Volatile Orgainics**	Diethylphthalate
Selenium		Dimethylphthalate
Silver	1,2,4-Trichlorobenzene	Di-n-Butyl Phthalate
Sodium	1,2-Dichlorobenzene	Di-n-Octyl Phthalate
Thallium	1,3-Dichlorobenzene	Fluoranthene
Vanadium	1,4-dichlorobenzene	Fluorene
Zinc	2,4,5-Trichlorophenol	Hexachloroethane
	2,4,6-Trichlorophenol	Hexachlorobutadiene
Volatile Organics	2,4-Dichlorophenol	Hexachlorocyclopentadiene
	2,4-Dimethylphenol	Indeno(1,2,3-cd)Pyrene
Chloromethane	2,4-Dinitrophenol	Isophorone
Bromomethane	2,4-Dinitrotoluene	Naphthalene
Vinyl Chloride	2,6-Dinitrotoluene	Nitrobenzene
Chloroethane	2-Chloronaphthalene	Phenanthrene
Methylene Chloride	2-Chlorophenol	Phenol
Acetone	2-Methylnapthalene	Pyrene
Carbon Disulfide	2-Methylphenol	
1,1-Dichloroethane	2-Nitrophenol	**Radionuclides**
1,1-Dichloroethene	3-Nitrophenol	
1,2-Dichloroethene	3,3-Dichlorobenzidine	Gross Alpha
Chloroform	4,6-Dinitro-2-Methylphenol	Gross Beta
1,2-dichloroethane	4-Bromophenyl Phenyl Ether	Uranium-233,-234,-235, and -238
2-Butanone	4-Chloroaniline	Americium-241
1,1,1-Trichloroethane	4-Chlorophenyl Phenyl Ether	Plutonium-239,-240
Carbon Tetrachloride	4-Chloro-3-Methylphenol	Strontium-89,-90
Vinyl Acetate	4-Methylphenol	Cesium-137
Bromodichloromethane	4-Nitroaniline	Tritium
		Radium-226, -228

Buildings 444/447/460

The current sampling station, FD-444-460, collects water from the storm sewer system and foundation drains of Building 444. A new sampling station, FD-447-1, is recommended at a manhole on the hillside outside of the fence, closer to the foundation drains. The current sampling location, FD-444-460, should be sampled concurrently for several sampling events for comparison to the new station.

Building 559

The foundation drain water is currently collected and transported via a vinyl hose to the sanitary wastewater treatment facility The vinyl hose is not appropriate for a long term solution and should be upgraded as soon as practicable It conditions change change such that the water is not collected for treatment, this station should be incorporated into the routine sampling program. Historically, foundation drain water from Building 559 emptied into the storm sewer system and was released at outfall FD-516-1 (Figure 8) A sediment sample should be collected at this location and laboratory-analyzed for semivolatile constituents and radionuclides (Table 10).

Building 707

The current sampling location (BS-707-2) is a vault north of Cooling Tower 709 A new sampling station, FD-707-4, is proposed at the storm drain manhole near the southeast corner of Building 707. The western inlet to the manhole would be sampled, if possible, to isolate the foundation drain waters from storm sewer discharge.

Building 771

The current sampling station, FD-771-1 (Figure 11), collects only a portion of the foundation drain waters for Building 771. It is proposed that a new sampling point (FD-771-4) be located at Manhole No. 3, near the northwest corner of Building 771 (Figure 11). This station would be more representative of the foundation drain water for Building 771.

Building 774 No changes to the current sampling program for Building 774 foundation drain waters are proposed at this time. This recommendation may change, however, when the information from the 24-hour CCTV footage is evaluated. The sediment at outfalls FD-774-1 and FD-774-2 (Figure 11) should be sampled for semivolatile compounds, radionuclides, and tritium based on the analytical data from the historical samples from these locations (Table 5).

Building 779 Based on the data compilation, the current sample location FD-779-1 is a storm drain, rather than a foundation drain outfall The correct sampling station is located ten feet east of the current station, and is sampled under the surface water program as SW85. Station FD-779-1 should be dropped from the current program, and the appropriate station should be named FD-779-2. This renaming is necessary for data integrity.

Building 850 FD-850-1 (formerly FD-860-1) has never been sampled and has been historically dry (Figure 14). Because Building 860 contains administrative offices and no production or manufacturing work has ever been performed here, the building foundation drains are not recommended for sampling.

Building 865 Samples from BS-865-1 (Figure 15) do not represent foundation drain waters. Therefore, station BS-865-1 should be deleted from the SWD sampling program. Sampling of foundation drain waters at location FD-865-2 should continue.

Building 886 Currently foundation drain water for this building collects in a sump and is sent to the Process Waste Treatment System (Building 374). No recommendations are proposed for this building as long as the water is continued to be treated at process waste.

Building 881 A new sampling station, FD-881-4 (Figure 16) be sampled once for the complete analytical list (Table 10) as part of the OU8 Stage 2 activities If no elevated levels are noted, then this location should not be sampled further.

Building 883 No elevated levels of constituents have been detected at sample station FD-883-1 (formerly BS-883-1) It is recommended that this station be deleted from the sampling program. (Figure 17)

Buildings 998/991 It is recommended that the manhole cover at the southeast corner of the building be removed to determine whether a foundation drain connects to the sanitary sewer at that location (Figure 18). If a connection exists, the foundation drain water is routed through the manhole to the sanitary sewer and processed in the sewage treatment plant. In this case, there is no need for further sampling. If a connection does not exist, routine sampling at BS-991-2 should continue until the routing of the foundation drain system can be determined.

Building 910 No recommendations are made at this time.

Building 995 No recommendations are made at this time.

Buildings 996/997/999 No recommendations are made at this time. However, sampling may be recommended when the foundation drain outfalls are located because these building store radionuclides and because the foundation drains have never been sampled.

Approved By

______________________ ___/___/___
Director (Date)

______________________ ___/___/___
Project Manager (Date)

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Quality Assurance Program Manager (Date)

5.0 INFILTRATION/EXFILTRATION

The infiltration and exfiltration into and out of the storm sewer and sanitary sewer lines at RFP were analyzed based on the limited information available This section identifies, on a macro scale, the locations where infiltration and exfiltration may occur at different seasonal water levels A comparison of the invert elevations of the sanitary and storm sewers against spring (high) and fall (low) 1992 water table elevations for the alluvial portion of the upper hydrostratigraphic unit is presented. This information was used in conjunction with previous studies and camera inspections to determine areas of the sanitary and storm sewer system which would be prone to infiltration or exfiltration of constituents through joints, cracks, and other breaks in the closed conduit Industrial area sanitary and storm sewer pipeline maps were prepared to illustrate infiltration- and exfiltration-prone areas.

This section includes a summary of previous documents and research performed for EG&G concerning infiltration and exfiltration in the storm sewer and sanitary sewer systems. A four-hour CCTV video tape of the 400 Area storm sewer lines was analyzed for possible deteriorated areas of the foundation drains where infiltration or exfiltration could occur. A 24-hour CCTV video footage of the storm sewer system for the entire plant is known to exist but could not be obtained for review for this draft technical memorandum. Because the 24-hour CCTV video tape of the storm sewer system for the entire plant was not available for review before the completion of this draft of the Technical Memorandum, the following evaluation is considered preliminary Efforts are currently being made to obtain the video. If it is classified, an individual with the appropriate clearance will then review the tape for information pertaining to this study It is believed that information from the video will be made available before this document is finalized.

5.1 INFILTRATION/EXFILTRATION PROCESSES

Infiltration into or exfiltration out of a pipeline can occur when the lines and manhole joints shift and settle and when material deteriorates as a result of age or other circumstances that may cause deterioration or misalignment of the storm or sanitary sewer systems. As groundwater levels fluctuate, these discontinuities in the pipeline may allow groundwater to enter or leave the sewer lines Inflow occurs when liquids are discharged directly into the lines from the normal storm and sanitary sources and may include rainfall or snowmelt from a precipitation event. This water enters the pipelines directly through catch basins, storm grates, or direct connections to other pipes or roof drains

5.2 REVIEW OF EXISTING DOCUMENTS

Several reports containing information about infiltration and exfiltration studies for the storm sewer and sanitary sewer systems at RFP were reviewed. *Sanitary Sewer Infiltration/Inflow and Exfiltration Study. Task 1 of the Zero-Offsite Water-Discharge Study* (ASI 1991b) characterized, to the extent possible, the presence, flow rate, and type of infiltration/inflow or exfiltration conditions that exist in the sanitary sewer system. *Non-Point Source Assessment and Storm-Sewer Infiltration/Inflow and Exfiltration Study: Tasks 2 and 3 of the Zero-Offsite Water-Discharge Study* (ASI 1991a) describes the preliminary results of two interrelated studies involving quantity and quality analyses of storm sewer infiltration and exfiltration and of a non-point source assessment. Additionally, CCTV video footage (ASI 1993) from the 400 area storm drains was reviewed for information relating to possible areas of infiltration and exfiltration

According to the *Sanitary Sewer Infiltration/Inflow and Exfiltration Study· Task 1 of the Zero-Offsite Water-Discharge Study* (ASI 1991b), approximately 6.5 million gallons per year (MGY) of infiltration and 6 4 MGY of inflow into the sanitary sewer system is estimated. ASI additionally reported that approximately 3 8 MGY exfiltrates from the system These estimated numbers include flow measurement errors of approximately 10 to 15 percent and waste water production rate errors (which affect the amount of exfiltration from the system) of approximately 10 to 20 percent Combined with the uncertainty resulting from cooling tower water discharges (frequency and amount of discharge unquantifiable), these infiltration/inflow and exfiltration estimates should not be considered reliable (ASI 1991b). The study concluded that rehabilitating the sanitary sewer system would not be cost effective and would be very difficult because of problems with excavation in IHSSs, utility and electric cables, and decreases in hydraulic capacity of the system

The *Non-Point Source Assessment and Storm-Sewer Infiltration/Inflow and Exfiltration Study· Tasks 2 and 3 of the Zero-Offsite Water-Discharge Study* (ASI 1991a) report estimates that the annual infiltration into the storm sewer system is approximately 26.2 MGY. No estimates of exfiltration from the storm sewer system were made The storm sewer system consists of more than 33,000 linear feet of piping and an estimated additional 33,000 linear feet of open channels. No discharge measurements have historically been made within the storm sewer system. Water quality in the storm sewer system varies and has no specific trend (ASI 1991a). To develop a better understanding of the storm sewer system, ASI recommended that further analyses and investigations be performed when additional data become available.

The four-hour CCTV video footage (ASI 1993) traced the storm drains in the 400 Area and nearby buffer zone. The storm sewer pipes in the 400 Area are primarily made from reinforced concrete. Several segments had hairline cracks, roots, and offset joints that were visible on the CCTV Additionally, connections to other pipes and roof drains were noted. Generally, the storm sewer pipes in the 400 Area are in fair condition

The 24-hour CCTV video footage of the entire storm sewer system of RFP would provide vital information regarding the integrity of the piping and connections with other pipes. When this video footage becomes available, the condition of the storm sewer system at RFP can be more accurately ascertained

5.3 APPROACH

A preliminary assessment of the areas of infiltration and exfiltration was made for the RFP sanitary sewer system based on the limited information available Invert elevations of the sanitary sewer system manholes were compared to the local (spring and fall 1992) water table This preliminary assessment will be refined after a review of the 24-hour CCTV video footage to determine pipeline integrity

The elevations of the sanitary sewer and storm sewer systems were obtained from engineering drawings (Appendix A), a field verified drawing of the storm sewer system obtained from Wright Water Engineers (WWE), the EG&G Plant Engineering CADVision database, and existing reports (ASI 1991a,b). Inconsistencies between these sources were resolved by assuming that the CADVision data files were most accurate for the sanitary sewer line locations. ASI manhole elevations, which had been field checked, were added to the CADVision maps for the sanitary sewer system The WWE drawing provided the most accurate elevations for the storm sewer system.

Figure 53 and 54 compare the high and low water table elevations from 1992 to the invert elevations of the sanitary sewer system. Hatched areas indicate zones of potential infiltration and exfiltration from the sanitary sewer system Insufficient elevation data were available for the storm sewer system Generally, many of the storm sewer segments are culverts or pipes buried within a few feet of land surface and thus should not be below the water table Therefore, most of these storm sewers should not be subject to significant amounts of infiltration

5.4 CONCLUSIONS

Based on the four-hour CCTV video of the 400 Area (ASI 1993), the storm sewer system for RFP does have infiltration and exfiltration potential Several areas of cracked, offset, leaking segments of pipe were visible on the video Assuming the 400 Area is representative of the entire storm sewer system and considering the age of the system, there is reason to believe that infiltration and exfiltration is occurring in the storm drain system Potential infiltration zones to the storm sewer system are highly variable In many areas, the storm sewer system consists of culverts located near the land surface. These segments are unlikely to transport constituents from OU8 IHSSs to groundwater In other areas, deeper storm sewer lines and foundation drains that connect to storm sewer lines may be potential pathways of constituent migration from OU8 IHSSs

The integrity of the sanitary sewer system could not be determined However, it has been documented that the sanitary sewer lines are subject to infiltration and exfiltration (ASI 1991b) The sanitary sewer system was rehabilitated in 1985 as well as during previous years. Many existing sanitary sewer lines were abandoned in place.

Zones of potential infiltration to the sanitary sewer system occur in the central portion of RFP and toward the eastern perimeter of the industrial area. Buildings in the vicinity of these zones of infiltration include Buildings 551, 552, 561, 707, 708, 709, 991, 998, 994, and 989.

Approved By

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Director (Date)

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Project Manager (Date)

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Quality Assurance Program Manager (Date)

6.0 AIR MONITORING

Extensive sampling and analyses of effluent and ambient air at RFP were performed. The effluent air monitoring program includes real-time screening, biweekly filter collection and screening, and a monthly filter composite analysis for radiological contaminants and beryllium The ambient air program involves continuous high volume air samplers in and around RFP

At the sampling locations shown in Figure 55, filters are composited monthly. Additional information about air monitoring at RFP is contained in the draft *Industrial Area Interim Measure/Interim Remedial Action/Decision Document* (EG&G 1994a).

Air monitoring programs for continuous stack effluent emissions, gaseous effluent emissions, ambient radioactive particulates, and ambient nonradioactive particulates are designed to collect data on the entire facility Potential radioactive air pollutant emissions include plutonium, americium, uranium, and tritium. Potential nonradioactive air emissions that are monitored include beryllium, oxides of nitrogen (NOx), total suspended particulates (TSP), and particulates smaller than 10 microns (PM-10). Primary chemicals that could be emitted are carbon tetrachloride (CCl_4), trichlorotrifluroethane (Freon TF®), 1,1,1-trichloroethane, hydrogen fluoride, nitric acid, phosphoric acid, and sulfuric acid. The primary types of emission sources are stacks, vents, tanks, ponds, landfills, and other diffuse sources.

Although many operations have been reduced or stopped, potential air emissions are still being controlled. All production and research facilities at RFP are equipped with ventilation/filtration exhaust systems for effluent emissions control Glove boxes are used for containment and filter plenum systems for effluent treatment Particulates are removed from the air effluent stream by high efficiency particulate air (HEPA) filters. Multiple banks of HEPA filters are called filter plenums Other controls at RFP include cyclones, baghouses, and electrostatic precipitators Acids and other chemical emissions are controlled by scrubbers and carbon filters (on a scale); efficient low oxygen burners for gas-fired steam generation are used to reduce NOx emissions

The RFP air quality programs are currently administered by the Air Quality Division (AQD) within the Environmental Protection Management (EPM) Department The Emergency Preparedness Offsite Systems (EPOS) branch of the Health and Safety Department supports emergency response actions Additional ambient air quality monitoring is performed by CDH

The RFP air monitoring system consists of four subprograms radiological effluent emissions, nonradiological effluent emissions, radiological ambient monitoring, and nonradiological ambient monitoring. RFP meteorological monitoring, weather forecasting, and air dispersion modeling complement the air monitoring program Operating procedures, calibration, maintenance, and analytical procedures for air monitoring systems at RFP are documented in RFP *Air Quality Sampling Standard Operating Procedures* (EG&G 1994b)

6.1 RADIOLOGICAL EMISSIONS MONITORING

RFP continuously monitors and samples radionuclide air effluent emissions as required by DOE Order 5400.1 and EPA 40 Code of Federal Regulations (CFR) 61, Subpart H. Subpart H establishes the effective dose equivalent of 10 millirem per year for any member of the public Both requirements mandate the continuous monitoring of radionuclide air emissions at all release points with the uncontrolled potential of discharging radionuclides into the air in quantities that could result in an effective dose equivalent greater than 0 1 millirem per year. An emission point that does not have this potential requires only periodic confirmation of low emissions through monitoring data or emission calculation. Because 54 of the ducts and vents have potential dose terms that are less than 0 1 millirem per year, only periodic confirmation of low effluent emissions is required (EG&G 1993a).

Although the fabrication and recovery operations have stopped, these facilities are still equipped with functioning ventilation/filtration exhaust systems for particulate control Building air is filtered with several stages of HEPA filters before being discharged into the outside atmosphere. Generally, two HEPA filter stages are used to filter air from uranium processes, and four HEPA filter stages are used in plutonium areas. The HEPA filters are individually tested and certified to be no less than 99 97 percent efficient Filters are tested for leaks after installation into a filter plenum (EG&G 1993a).

There are approximately 130 emissions samplers in 63 air exhaust ducts within 17 buildings at RFP. The samplers are located downstream of the HEPA filter plenum. Particulate samples from each exhaust system are composited into monthly samples for specific laboratory analysis of the plutonium, americium, and uranium isotopes following a Total Long-Lived Alpha (TLLA) activity screening. These samples are also used for beryllium analyses.

The radiological particulate monitoring and sampling program uses a three-tier approach comprised of Selective Alpha Air Monitor (SAAMs), TLLA particle screening of routine air duct effluent emission sample filters and radiochemical analysis of isotopes collected from air duct effluent emission samples. This approach balances both sensitivity of detection and timeliness of response for each tier.

6.1.1 Selective Alpha Air Monitors

The first tier of air monitoring at RFP is based upon 39 SAAMs in the air monitoring program measure real-time alpha activity in air effluent ducts at RFP These in-stack monitors are positioned downstream of HEPA filter plenums and are set to detect plutonium-239 and plutonium-240 SAAMs are not designed to provide quantitative measurements of routine plutonium concentrations in air effluent, and no data record is maintained for continuously detected count rates. They are the least sensitive but most timely of the three tiers (Daugherty 1989) SAAMs initiate visible and audible alarms if the alpha particle activity in the effluent air reaches the plant's internal operating alert levels The units are connected to a system in the radiation monitoring offices and selected utilities offices that provides remote readout and recording of real-time data when an alarm occurs These offices are staffed 24 hours a day, seven days a week. SAAM operations and any related quality assurance functions are performed by Radiological Operations and are not the responsibility of the AQD SAAM operations and QA functions are not intended to meet the monitoring and QA requirements of 40 CFR 61, Subpart H (EG&G 1993a).

6.1.2 Particulate Emissions Monitoring

Tiers two and three involve particulate monitoring of filters collected from 130 in-stack samplers. Currently, particulate emission samplers extract samples in either a subisokinetic or superisokinetic manner. After EPA approval, all samples will be adjusted to operate at a subisokinetic rate of extraction (i.e., in a manner where the linear velocity of the gas entering the sample nozzle is less than that of the undisturbed gas stream at the sample point). This method tends to bias toward the excess collection of large particulates (greater than 5 microns) and yields a measured concentration of particulates greater than the actual concentration in the duct effluent (EG&G 1993a)

TLLA screening is more sensitive than the SAAM but requires a minimum of approximately three days for results to become available. Preparation, collection, and disposition of particulate filters follow RFP air quality sampling standard operation procedure 4-C83-ENV-AP.03, Effluent Air Radioparticulate Sample Collection. If a sample exceeds the RFP internal emissions action limit of 0.02 picocuries per cubic meter, an investigation is initiated to determine the cause of the off-normal concentration and evaluate the need for corrective action (EG&G 1993a)

6.1.3 Gas Monitoring

Tritium is the only gaseous radioactive emission material that is routinely monitored at RFP. Although tritium is typically not generated at RFP, a shipment that was received from another facility in 1973, unknown to RFP personnel, had become contaminated with this material at another facility. Thus, tritium monitoring is necessary to prevent recurrence of such an incident

Tritium is monitored at six locations through the collection of tritium in water-filled bubbler impingers located in building effluent systems Samples are drawn continuously and collected three times per week. Laboratory analyses are conducted on each subperiod sample by counting the low energy electrons released from the decay of tritium.

6.2 NONRADIOLOGICAL EMISSIONS MONITORING

Nonradiological emissions monitoring for beryllium and VOCs is performed at RFP. Beryllium is the only nonradiological particulate emission from stationary sources monitored at RFP.

Particulate samples are collected at 63 effluent stack locations for beryllium analysis. Samples are collected from the same filters used for radiological analyses. The emission standard for beryllium is less than 10 grams in a 24-hour period; the total quantity of beryllium discharged from ventilation exhaust systems in 1992 was 3.399 grams (EG&G 1993b).

VOC emissions are not monitored by EG&G at RFP. However, VOC emissions are estimated from chemical inventories and quantities of these materials used VOC emissions are reported in the Air Pollution Emission Notices

6.3 RADIOLOGICAL AMBIENT AIR MONITORING PROGRAMS

The Radiological Ambient Air Monitoring Program (RAAMP) includes general RFP and the OU-specific monitoring programs, the samplers are identical but the rationales for sampler location and use differ between the programs. The CDH Radiation Control Division Surveillance Program monitors ambient air concentrations of long-lived gross alpha and gross beta radioactivity in suspended particulate material Analytical results from the CDH samples are summarized in the CDH Environmental Surveillance Report distributed at the Monthly Information Exchange Meetings Analytical results from RFP-operated RAAMP samplers are also reported at the Monthly Information Exchange meetings.

6.3.1 Radioactive Ambient Air Monitoring Program

The RAAMP objectives are to track the dispersion of airborne radioactive materials from RFP into the surrounding environment and communities, and establish baseline concentrations. Radioactive air monitoring is required by DOE Order 5400.1. Data collected are used to determine the public inhalation dose and are compared to the DOE standard for exposure for all pathways from routine plant operations Forty-seven locations at RFP and nearby communities are sampled continuously

6.3.2 Community Radiation Monitoring Program

The Rocky Flats Plant Community Radiation Monitoring Program (ComRad) is a cooperative effort of the DOE, EG&G, and the communities surrounding RFP ComRad involves citizen-operated environmental air surveillance stations (EG&G 1994b) One ComRad station is located in each of the cities of Broomfield, Arvada, Westminster, Northglenn, and Thornton Each ComRad sampling station is equipped with a RAAMP-type sampler, a gamma detector, a thermoluminescent dosimeter, and meteorological monitors.

6.3.3 Operable Unit-Specific Monitoring

This program is designed to comply with ambient environmental air sampling requirements in conjunction with remediation at contaminated sites at the plant The *Plan for Prevention of Contaminant Dispersion* (DOE 1991b) and EG&G's *Environmental Monitoring Division Operating Procedures* (EG&G 1994b) describe requirements and procedures for suspended particulate monitoring. Environmental investigations were planned to be conducted at 16 OUs Any soil disturbance, such as monitoring well installation or test pit excavation, could result in release of material to the air medium. Monitoring programs will depend on planned activities, potential exposure pathways, and the contaminants of concern and will be designed to monitor for worker protection and to measure concentrations leaving the work area. OU-specific human health evaluations include characterization of contaminants, of potential exposures, and of the potentially exposed population to determine the risks that need to be reduced or eliminated and the exposures that need to be prevented.

6.4 NONRADIOLOGICAL AMBIENT AIR MONITORING

Ambient particulates are regulated by EPA and CDH under the Clean Air Act and its amendments, as defined by the National Ambient Air Quality Standards and Colorado Air Quality Control Commission Ambient Air Standards. Both TSP and PM-10 are monitored by RFP at one nonradiological particulate air sampling location. PM-10 replaced TSP as the EPA-designated reference method (40 CFR 50.6) (EPA 1982) for ambient particulate matter, but TSP sampling has continued because the results have several applications. Sampling for a broad particulate size range serves the following purposes: (1) internal management tool; (2) baseline data record, and (3) cross-comparisons with nonroutine ambient radiological particulate sampling studies

6.5 EMERGENCY RESPONSE

The RFP Emergency Plan (EG&G 1993c) establishes the planning, preparedness, and response concepts for emergencies at the facility. Response measures provide protection for the health and safety of onsite personnel and the public, limit damage to facilities and equipment, minimize impact to onsite operations and security, and limit adverse impacts on the environment. The RFP Emergency Plan also outlines the relationships and coordination with offsite federal, state, local, tribal, and private agencies, governments, and organizations regarding emergency response.

The *Air Quality Management Plan* (EG&G 1994b) summarizes the RFP emergency preparedness response capabilities and activities from an air programs perspective. A site-specific dispersion model, the Terrain-Responsive Atmospheric Code (TRAC), was developed by RFP to predict plume path and impacts in a region of complex terrain and rapidly changing meteorology with sufficient accuracy to support protective action decisions by managers in a crisis environment

The TRAC model is continuously operated by the Emergency Preparedness Offsite Programs group of Plant Safety and Security. The model supports a variety of missions including emergency response, emergency planning, risk assessment, hazards analysis, and regulatory compliance. The Emergency Operations Center has used a version of the TRAC model to produce more than 15,000 automatic plume projections. The model estimates plume path, concentration, and dose (EG&G 1994b)

Approved By·

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Director (Date)

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Project Manager (Date)

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Quality Assurance Program Manager (Date)

7.0 ADDITIONAL DATA COMPILATION, IHSSs 118.1, 118.2, 150.6, 150.8, 151, 172, 184, and 188

Additional data compilation tasks for IHSSs 118.1, 118.2, 150 6, 150 8, 151, 172, 184, and 188 were identified in the OU8 Work Plan (EG&G 1992a). The objective of this data compilation effort is to determine whether the proposed sampling as outlined in the field sampling plan is complete based on this additional information The following sections present a summary of the additional information by IHSS. In addition, a brief description of the proposed Stage 2 sampling efforts as summarized from the OU8 Work Plan (EG&G 1992a) is included with additional sampling recommendations if appropriate. Information reviewed to compile the data included, aerial photography (high and low altitude), engineering drawings, major and minor construction contracts, the Historical Release Report (EG&G 1992b), and interviews with Rocky Flats personnel.

7.1 SOLVENT SPILLS (IHSS 118.1)

IHSS 118.1 is related to a 5,000-gallon underground steel storage tank that contained carbon tetrachloride. The tank was located adjacent to the west side of Building 730, just north of Building 776. A spill of 100 to 200 gallons of carbon tetrachloride north of Building 776

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occurred sometime before 1970. On February 26, 1976, corroded piping leaked an unknown quantity of carbon tetrachloride into the tank's valve pit. On June 18, 1981, the tank failed, releasing an unknown quantity of carbon tetrachloride into the valve pit. Following this failure, the tank was removed. The OU8 Work Plan (EG&G 1992a) indicates that the Stage 1 activities will determine whether the concrete containment was removed when the tank was removed. This information will aid in determining the Stage 3 investigations. These investigations require a soil boring be placed where the valve pit was located in order to determine whether the valve pit was removed Information regarding the concrete containment was not found before the completion of this draft of the document. Given the construction of the tank, if the tank was removed, the valve pit likely was removed at the same time. All surface evidence indicates the concrete was removed. However, the concrete could also have been demolished and backfilled material placed on top so the concrete may be below grade.

7.2 SOLVENT SPILLS (IHSS 118.2)

In June 1981, a 5,000 gallon, aboveground carbon tetrachloride tank located within a bermed area between the north side of Building 707 and the alleyway south of Building 778 ruptured and leaked an unknown quantity of carbon tetrachloride onto the ground. The OU8 Work Plan (EG&G 1992a) indicates that the Stage 1 activity for this IHSS is to determine whether the tank was removed from the site and whether unknown access problems exist at this time. Based on conversations with Mr. Fiore, EG&G Technical Support for Operations at Building 707 (Fiore 1994), the tank has not been removed and currently contains approximately 3,500 gallons of carbon tetrachloride. This information will be used when determining the investigative activities for Stage 3 of this RFI/RI.

7.3 RADIOACTIVE SITES (IHSS 150.6 AND IHSS 150.8)

In 1969, an empty drum with plutonium-contaminated residual waste oil was cut apart near a dock at Building 779 and was spread by pedestrian tracking to the east of Building 779. The main dock for Building 779 is located along the northern half of the east side of the building. The surface in this area is currently relatively flat and mostly paved. Stage 1 activities as identified in the OU8 Work Plan (EG&G 1992a) include determining the pavement history of this IHSS.

Review of aerial photographs and engineering drawings indicates that the areas affected by IHSSs 150.6 and 150.8 consist of both paved and unpaved areas. The eastern portion of the area outside Building 779 was paved before the incident in 1969 Portions of the IHSS that were unpaved or covered by gravel include the northernmost strip of the IHSS area, the area immediately adjacent to the north side of the building, and the southern portion of the IHSS directly adjacent to the southern side of the building. The remainder of the IHSS includes paved roads and walkways north and south of the building. Some pavement to the south and the east of the area was removed in 1979. Appendix G lists the engineering drawings reviewed for determining the pavement history.

A number of aerial photographs were reviewed to recount the pavement history of the area surrounding Building 779. In general, the paved area at the time of the June 22, 1969 release appears to be similar to the current paved area identified in the photographs of the IHSS submitted with the OU8 Work Plan. Low-angle aerial photography from June 5, 1969 and July 11, 1969 indicate that the area north of the building appears to be a mixture of paved and gravel areas Specifically, a walkway-driveway adjacent to the north side of the building appears paved, while the northern abutting courtyard-type area appears to be gravel or dirt. This dirt area is flanked on the north by a paved road. In all of the aerial photos reviewed since 1968, the area on the east side of the building appears paved. A June 5, 1969 aerial photo indicates that the paved roadway continues along the east side of the building and curves around to the south side of the building. An April 29, 1967 aerial photograph suggests that a gravel area exists adjacent to the south side of the building with a paved roadway area to the south of the gravel May 15, 1971 and May 25, 1971 aerial photographs also show the south side of the building with the paved roadway along the south side of the building. In these two photographs, the southeast portion of the building appears to have several feet of gravel between the building and the roadway.

The following aerial photographs were reviewed for these IHSSs:

Date	Rocky Flats Number	Photo Type
April 29, 1967	(CAPs Reorder #16965, Frame 127-207)	aerial
June 5, 1969	13676-03	low-angle
June 5, 1969	13676-09	aerial
July 11, 1969	13771-07	aerial
May 15, 1970	14444-08	aerial
May 25, 1971	15334-09	low-angle

The following is the pavement history of IHSSs 150.6 and 150.8 as identified in Engineering Drawings·

Date	Description
1964	The roadway east of the building is paved and some areas immediately adjacent to the eastern side of the building are concrete; the loading dock ramp north of the building is mostly concrete with some asphalt on the east end; gravel is adjacent to the south side of the building with a paved roadway to the south of the gravel. Engineering drawings referenced were those used for the initial construction of the building (RF-W/79-C) (Norman Engineering 1964).
1968	Building 79A was constructed and the courtyard area north of the loading dock was gravel-surfaced as shown in engineering drawing RF-B5-20111-01 (Lovell-Osnes-Nisbet Co 1968).
1976	In a 1976 engineering drawing (25682-XC2), the roadway is rerouted on its western end, but is altered far enough west not to affect the IHSS boundaries (Rockwell 1976).
1979	The paved areas east and south of Building 779 were removed to improve surface drainage as shown in engineering drawing 27673-XO4A-4 (Rockwell 1979).
1984	Engineering drawing 28842-XO2 indicates that South 79 Drive, which runs north-south along the eastern side of the building, was repaved in 1984 (Rockwell 1984).

Stage 2 investigative activities as defined in the OU8 Work Plan (DOE 1992a) include conducting an in-situ surface radiological survey, a soil-gas survey, and surface soil sampling below pavement. Based on the new information collected for this report, it is apparent that pavement existed prior to the 1981 carbon tetrachloride release. Therefore, it is proposed that three asphalt samples be added to the Stage 2 activities and analyzed by laboratory High Purity Germanium (HPGe) (Figure 56).

7.4 FUEL OIL LEAK (IHSS 151)

In August 1981, approximately 196 gallons of No. 2 diesel fuel were spilled on the surface soil north of Building 374 while filling a 47,500 gallon underground storage tank, which was installed in 1980. This tank supplies diesel fuel to two emergency generators in Buildings 371 and 373. A second release of approximately 50 gallons of No. 2 diesel fuel occurred in July 1982. A third spill of approximately 120 liters of No. 2 diesel also occurred in this area in October 1982 A final spill of 20 gallons of No. 2 diesel occurred in September 1988 when a valve was left open. The degree of cleanup of the releases is uncertain (EG&G 1992a). Stage 1 activities as defined in the OU8 Work Plan (EG&G 1992a) indicate that a document review of the tank inspection records is required to determine whether the tank has recently been tested and the results of these tests.

Tank D262 is referred to as Tank 381 N and Tank No. 4 in recent reports prepared for EG&G regarding Underground Storage Tank (UST) Studies at RFP (Table 13) The following reports refer to the IHSS 151 tank:

1988 In the Phase I UST study, it was recommended that the tank be replaced and that six 20-foot soil borings be drilled around the tank and piping. Three samples per boring were to be tested for chemical analyses (benzene, toluene, xylene, and oil and grease) (Parsons 1988). No analytical data were located confirming that this sampling occurred.

Table 13 - IHSS 151 Report Review

Date	Title of Report	Contractor
April 1988	*Task 1 Report of Underground Storage Tank Study*, Rocky Flats Plant, Golden, Colorado	Ralph M. Parsons Company
September 1988	*Underground Storage Tank Testing Results, Phase II Report*	Engineering-Science, Inc. and Ralph M. Parsons Co.
April 1990	*Underground Storage Tank Study, Phase II Tank Testing Results*	Engineering-Science, Inc. and Ralph M. Parsons Co.
June 17, 1991	*Annual Underground Storage Tank Tightness Testing - 1990*	Merrick & Company
March 27, 1992	*Underground Storage Tank Tightness Testing - 1991*	Merrick & Company
March 1992	*Underground Storage Tank Enhanced Conceptual Design Report*	Flour Daniel, Inc.

The tank was not able to be tested by either the Associated Environmental Systems (AES) or the Heath Petro-Tite tank tightness testing systems because of the poor condition of the tanks in 1988. Multiple system above grade leaks prevented the use of high-level testing, and low level testing required more sensitive equipment because of large surface areas in multiple manwells. It was recommended that the system be retested after repairing the fuel lines and pumps or when more sensitive equipment became available. It was expected that this equipment would become available three to four weeks after the date of the report. The report also suggested replacing the tank system as an alternate to repair (Engineering Science et al. 1988).

1990 AES tests could not be conducted until repairs were made A test was performed on October 26, 1989, but the results were inconclusive due to excessive air in the tank system. After taking measures to bleed all air from the system, a tank tightness test was conducted on November 8, 1989 The system passed (Engineering Science et al. 1990).

1991 On December 4, 1990, the tank and piping passed the tank tightness test with no recommendations. A hydrostatic product line test was conducted on the piping on December 22, 1990; the piping passed with no recommendations (Merrick 1991).

1992 On February 20, 1992, both the tank and the associated piping passed the tank tightness test. A test of the 2-foot product line was conducted on February 17, 1992 and the product line passed (Merrick 1992).

Because of regulatory requirements that require all existing UST systems to either meet the new UST system standards or meet the upgrade requirements by December 22, 1998, the UST Enhanced Conceptual Design Report of March 1992 recommended that the tank be replaced with a new tank (Fluor Daniel 1992) The Flour Daniel report identified this tank as a fiberglass-reinforced plastic tank that was installed in 1977.

The OU8 Work Plan (DOE 1992a) indicates that a pressure test of the tank and ancillary lines be performed if the records are out of date in the Stage 2 investigations. The latest pressure test was conducted in 1992, so no further testing is recommended at this time.

7.5 CENTRAL AVENUE WASTE SPILL (IHSS 172)

IHSS 172 follows a path formerly used by vehicles to transport drums of waste between the 903 Pad where the drums were stored and the waste treatment facility in Building 774 In June 1968, one or two drums of oil containing plutonium leaked along Central Avenue while in transit. The leak resulted from the drum contents sloshing through an improperly sealed bung during transport. The OU8 Work Plan (EG&G 1992a) indicates that Stage 1 activities for this IHSS will include clarifying the paving history of the contaminated section of the roadway and investigating the location of the old ditch.

Based on the visibility of dashed white center lines in aerial photographs from 1966 and 1968, Central Avenue was paved at the time of this June 11, 1968 spill A brief review of engineering drawings was made with regard to Central Avenue The following summarizes the information obtained from the drawings·

Date	Description
1952	Central Avenue was one of the original primary roads constructed at the plant as shown in 1952 engineering drawings (Appendix G, Austin 1952).
1963	Engineering drawings (RF-AH/202) indicate that the "A Road" (Central Avenue) was seal-coated in late 1963 (Appendix G, Dow 1963).
1965	Sidewalks were installed along the "A Road" (Appendix G, Rockwell 1987).
1972	New sidewalks were installed along the north side of Central Avenue (Appendix G, Dow 1972).
1975	Eighth Avenue including its intersection with Central Avenue was repaired (Appendix G, Rockwell 1975).
1976	A portion of Central Avenue north of the 400 Area buildings was replaced (Appendix G, Rockwell 1976).
1982	Road repairs were made to Central Avenue based on engineering drawing 27956 (Appendix G, Rockwell 1982).
1984	Central Avenue was upgraded based on engineering drawing 28842 (Appendix G, Rockwell 1984).

Based on review of aerial photographs from 1953 to the present and review of major and minor work orders and contracts since plant inception, no *obvious* realignment of the Central Avenue

Ditch has taken place along the main portion of Central Avenue. Conversations with Tom Trujillo, who has been in the Civil Engineering Department at RFP since the early 1970s, indicated that it was unlikely that realignments of the Central Avenue Ditch had taken place prior to the early 1980s (Trujillo 1994) In 1982, it is likely that the far eastern portion of the ditch was realigned during the construction of the Perimeter Security Zone (PSZ). An October 5, 1983 aerial photograph shows the southeast corner of PSZ and its probable influence on the Central Avenue Ditch alignment.

The following aerial photographs pertaining to Central Avenue and the Central Avenue Ditch were reviewed:

Date	CAPs Reorder Number
April 15, 1966	Frame 123-263, #16965
April 10, 1968	Frame 129-386, #16965
October 5, 1983	(RFP PIC No. 88760, Frame 483-26)

Various other annual aerial photographs from 1955 to the present.

Stage 2 activities as defined in the OU8 Work Plan include insitu radiological surveys using HPGe and sodium iodide (NaI) detectors and vertical soil profile samples collected below the pavement. Based on the data compilation prepared for this report, it appears that portions of Central Avenue, and the path the forklift took carrying the leaking drum have been replaced. Other sections of Central Avenue however, appear not to have changed since the 1968 incident Therefore, it is recommended that asphalt samples also be collected and analyzed for laboratory HPGe (Figure 57). These asphalt samples will be located based on HPGe and NaI results.

7.6 RADIOACTIVE SITE (IHSS 184)

The area southwest of Building 991, near Building 992, was used between 1953 and 1978 to steam clean radioactively contaminated equipment and drums. The rinse water was collected in a sump for treatment in the RFP's process waste system. No documentation exists that delineates the location of washing activities; however, the paved area between Building 992 and the south dock may have been used for steam cleaning. The OU8 Work Plan (EG&G 1992a) indicates that, as part of Stage 1 activities, the pavement history for the paved area between Building 992 and the south dock will be investigated.

The pavement history of the area west and southwest of Building 991 was confirmed by review of the following engineering drawings (Appendix G):

1951 The area east of Building 91 and north of Building 92 was paved at the time of building construction as shown in drawing RF-91&98-Y-1 (Dow, 1951)

1960 An addition was made to the west dock as shown in engineering drawing 1-6517-91 (Dow 1960)

1968 The area between Building 992 and Building 991 was re-paved in 1968 (Rockwell 1987)

1986 The pavement west and north of the west dock and a strip southwest of the dock was removed as shown in engineering drawing 28738-XO3 (Rockwell 1986) Engineering drawing 28738-03 suggests that a new asphalt surface course was replaced in areas where the asphalt was removed (Rockwell 1986).

The area is currently paved and appears paved in annual aerial photographs from the mid-fifties to the present. Appendix G lists the engineering drawings reviewed for completion of this task.

Since the pavement in the dock area had been removed and replaced in 1986, well after the steam cleaning activities, the initial Stage 2 recommendations as outlined in the OU8 Work Plan should be followed These include an in-situ radiological survey and collection of vertical soil profile samples.

7.7 ACID LEAK (IHSS 188)

In 1983, a 55-gallon steel drum located near the east gate of Building 374 and containing nitric and hydrochloric acid leaked. It is suspected that the mixture was a waste metal leaching solution originating from the 400 Area, which suggests that it might have contained some trace heavy metals The OU8 Work Plan indicates that Stage 1 activities will include further investigation of which heavy metals may have been present in the drum

Because the source of the drum containing the acid is unknown, the trace metals potentially present in the acid cannot be definitively identified. The following discussion identifies possible metals that could have been in the acid if the original source was any of the 400 Buildings or Building 371, which used acid in their operations.

Nitric acid was used in Buildings 444 and 445 for production etching and plating, titanium stripping, and assembly etching. War Reserve and special order parts fabricated from copper, steel, and stainless steel, were etched and plated using nitric acid. Assembly etching was performed on uranium parts using an ultrasonic etching bath with a solution of nitric acid, hydrogen peroxide, and deionized water. Titanium stripping involved immersing titanium-coated fixtures in an acid solution Hydrochloric acid was not specifically identified as being used in these buildings (ChemRisk 1992). Nitric acid was used for stainless-steel possivation in other buildings, including Building 881.

Metals identified as being used in Buildings 444, 445, 447, 448, 450, and 451 but not mentioned in the context of acid-related processes included depleted uranium, depleted uranium alloys, silver, aluminum, copper, beryllium, and trace quantities of iron and other cast metals (ChemRisk 1992). Building 460 was not constructed until 1984; therefore, it is not considered a possible source for the material spilled at this IHSS.

One final possible source of the hydrochloric and nitric acids is Building 371, which used both hydrocholoric and nitric acid in its plutonium analytical support and chemical standards laboratories. The acids were used for sample preparation, presumably for plutonium samples. No mention is made of trace metals in context of this use nor is a waste metal leaching solution mentioned (ChemRisk 1992).

Stage 2 investigations for this IHSS include the collection of surficial soil samples below pavement to be laboratory analyzed for pH, nitrate, and TAL metals In addition to the TAL metal list, it is recommended that the soil samples be laboratory analyzed for titanium, tritium, and uranium

Approved By

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Director (Date)

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Project Manager (Date)

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Quality Assurance Program Manager (Date)

8.0 SUMMARY

The OU8 Stage 1 data compilation activities included onsite reconnaissance, interviews with knowledgeable personnel, evaluation of pertinent engineering drawings, evaluation of aerial photography, a review of tank inspection records, evaluation of analytical data, evaluation of groundwater elevation data, and a review of CCTV video footage. The locations of foundation drains were compiled and maps were prepared. Analytical data from foundation drain and building sump sampling events at RFP were compiled and evaluated. An evaluation of exfiltration and infiltration from sanitary and storm sewers was also performed based on available data The current air monitoring conducted at RFP was investigated and summarized Finally, the history of several IHSSs within OU8 was investigated to supplement the OU8 Work Plan information. The following provides a brief summary of the major findings of these data compilation tasks

8.1 LOCATION OF FOUNDATION DRAINS

An evaluation of the location of foundation drains was performed building by building Comparisons were made to the current known locations of foundation drains supplied by EG&G SWD. In some instances, current sampling locations were found to be representative of storm water rather than foundation drain water. In other instances, drains were located that were not previously known. These findings are summarized building by building:

111 The current sampling location (BS-111-2) is a sump in the south end of the Building 111 basement Based on available information, the sump is a collection point for the floor drains of the building The foundation drain outfall for Building 111 has not been located. It is suspected that the drains discharge at an outfall (which is currently buried) to the north of the building. Samples were collected from Station FD-111-2 located in the drainage ditch north of Building 111 from 1978 to 1991 The station is not currently sampled because the outfall is normally dry

124 The foundation drains for this building were found to be located around the exterior of the foundation This water collects in a sump on the east side of the building and then discharges to settling tanks that are part of the backwash treatment system This drain has never been sampled

371/374; 517/518 The foundation drains for these buildings are located around the perimeter and beneath the foundations. Foundation drain water discharges at six outfalls, three for each building complex These outfalls drain to a north-flowing drainage ditch that contributes water to North Walnut Creek. Samples are currently collected from one of these foundation drains, at Station FD-371-3.

440 No foundation drains were determined to exist for this building

444 The foundation drain for this building drains the southern end of the basement and leads to a sump. The sump discharges to the process waste system and is treated in Building 374 The foundation drains for Building 444 have never been sampled.

447 A foundation drain exists on the western half of the basement foundation and joins a storm drain that runs north and south underneath the building. This water discharges to an outfall to the south of Building 664. This outfall is currently being sampled

559 No foundation drain was found for Building 559, however, there is a drain for the tunnel that connects Building 559 to 561 Pits located in both buildings also have foundation drains that connect to the tunnel drain. These waters are discharged to a sump located between the two buildings near the northwest corner of the 561 pit The sump historically discharged to the storm sewer, which led to an outfall on the hillside west of Substation 516 Currently, the water is pumped from the sump to the sanitary sewer system. Both the sump (FD-559-561) and the outfall (FD-561-1) have historically been sampled.

707 Foundation drains exist under Building 707 and tie into the storm sewer system at the southwest corner of the building. The storm sewer outfalls east of Building 707, at the 750 culvert, and the water eventually enters the B-series ponds Sampling is currently conducted at BS-707-2, a vault next to the cooling tower south of the building The source of water in the vault is likely to be surface water runoff and/or groundwater infiltrating through cracks in the concrete rather than foundation drain water

771 The foundation drain system for this building has three discharge locations on the northwest side of the building The first is a pipe that discharges to Manhole No

2250|241

3 near the northwest corner of the building. This manhole is connected to the storm sewer, which discharges to a small pond on the north side of Building 774 The second outfall is located on the west side of Building 771, and it discharges to the ground surface The third and last outfall discharges to the storm sewer near the western addition and is currently sampled as FD-771-1.

774 Foundation drains located around the perimeter of this building drain to three outfalls The first outfall discharges from a storm drain and flows into a small pond north of the building and then into North Walnut Creek, or possibly the OU4 Interceptor Trench system. The second outfall also discharges to the pond However, because of recent construction, this drain has likely been blocked The last outfall discharges through a storm drain located on the hillside northeast of the building The first outfall (FD-774-1) is the only one that has been sampled

779 A foundation drain was constructed for the addition of this building The drain is connected to a storm drain that discharges to the hillside north of the solar ponds, which in turn is collected by the OU4 treatment system Sampling is currently conducted at FD-779-1, an outfall north of the Solar Ponds The source of this water is likely to be storm water rather than Building 779 foundation drain water.

850 The foundation drains for this building discharge to an outfall on the hillside south of the building This outfall was selected for sampling in the past, however, it is often dry and is not part of the current sampling program

865 Foundation drains for Building 865 flow to a sump on the west side of the building The sump discharges to the east to an outfall located behind the 800 Area guard post The sump (BS-865-1) is sampled under the current program

881 This building has three separate foundation/underdrain systems that discharge to different locations. The first is a foundation drain system that runs around the perimeter of Buildings 881 and 887 This system discharges to a sump on the hillside south of the 800 Area The second system collects roof drain water and ties into a sub-basement storm drain system, which discharges to a wetland south of the building This foundation drain water makes its way to a sump and pump station which pumps to the OU1 Interim Measure/Interim Remedial Action treatment facility The third discharge is from the utility tunnel network and floor drains, which discharge to a sump in the boiler room near the south end of the building The sump discharges to the sanitary sewer system The first and third discharges have been historically sampled.

883 The foundation drain system discharges to sump at the southwest corner of the building, which in turn is connected to a storm drain that discharges to the ground surface west of Building T883D. The sump is currently sampled as FD-883-1, but the outfall has never been sampled

887 The foundation drain system for this building is connected to Building 881.

910 The drain system for this building collect at a sump, and discharges to the ground surface northeast of the building This sump is currently sampled as FD-910

991/998 These two buildings are connected by a tunnel that has a foundation drain system These drains flow toward the east and historically discharged to a ditch on the eastern side of Building 991. This outfall has historically been sampled

995 Drains from this facility likely discharge to three outfalls south of the facility However, these drains were sludge bed underdrains that may not have existed or may have been altered by the relining of the sludge beds These outfalls were not observed during site reconnaissance None of these outfalls has been sampled

996,997, 999 Foundation drains for these structures are believed to be connected to a storm sewer east of Building 991 These drains have never been sampled

8.2 FOUNDATION DRAIN WATER QUALITY

Analytical laboratory data were located and evaluated for the foundation drain water Analytical results from foundation drain samples were available for 1977 through 1993 Data were not available for 1984 through 1987, although samples may have been collected during two of those four years Dow Chemical Company reportedly may have sampled foundation drains before 1977, however, supporting documentation and data could not be located The following highlights the significant findings of the analysis·

- Gross alpha and gross beta concentrations appear to have generally decreased from 1977 to 1993 It is not known how changes in analytical technologies and methods may have affected these results

- Metal concentrations exhibited no apparent trends This may be a result of the inconsistency of sample collection. Although the analytical reports before 1991 are unclear. It is suspected that both dissolved and undissolved metal samples were collected. Some metals do consistently show levels above baseline criteria, most notably aluminum

Recommendations for both OU8 Stage 2 investigative activities and changes to the current SWD sampling program were developed based on the analysis of locations of foundation drains and the laboratory analytical results These recommendations are summarized in Table 13

8.3 INFILTRATION/EXFILTRATION

The infiltration and exfiltration into and out of the storm sewer and sanitary sewer lines at RFP were analyzed based on the limited information available. Areas of infiltration and exfiltration were identified based on invert elevations of the sanitary sewers and groundwater elevations obtained from the spring (high) and fall (low) 1992 data The 24-hour CCTV videotape of the storm sewer system for the entire plant was unavailable and, therefore, was not reviewed before the completion of this draft of the Technical Memorandum. Therefore, the evaluations made for this section are considered preliminary and are subject to change after the storm sewer videotape information is evaluated

Infiltration into or exfiltration out of the storm or sanitary sewer system pipelines can occur when the lines, and manhole joints, materials undergo deterioration due to age or other circumstances that may cause shifting, offset, deterioration, or corrosion As groundwater levels fluctuate, these deteriorated areas may allow groundwater to enter or leave the sewer lines

Several sources of information were used to create infiltration and exfiltration maps of the site. These included discharge study reports, a four-hour CCTV coverage of the storm sewer system in the 400 Area, and preliminary calculations on the area of influence of foundation drains In addition, elevations of the sanitary sewer and storm sewer systems were obtained from engineering drawings, a field-verified drawing of the storm sewer system, the EG&G Plant Engineering CADVision database, and existing reports These sources of data were input into the ARC/Info Geographic Information System software for creation of the maps

Based on the limited information available, areas of infiltration and exfiltration were identified Zones of potential infiltration to the sanitary sewer system occur in the central portion of RFP and toward the eastern perimeter of the site Buildings in the vicinity of these zones of infiltration include Buildings 551, 552, 561, 707, 708, 709, 991, 998, 994, and 989

8.4 AIR MONITORING

Information regarding the current air monitoring program at RFP was collected and summarized The following briefly presents the major findings of this data compilation

- Air effluent emissions from plant operations are continually measured and characterized for the Industrial Area, and ambient air in and around RFP is continuously monitored for radiological and nonradiological particulates.

- The primary types of emission sources are stacks, vents, tanks, ponds, landfills, and other diffuse sources Air monitoring is performed continuously on stack effluent emissions, gaseous effluent emissions, ambient radioactive particulates, and ambient nonradioactive particulates This monitoring is designed to collect data on the entire facility.

- As a result of the change in the plant mission from nuclear weapons production to environmental restoration, many operations have been reduced or stopped Potential air emissions however, are still being monitored.

- Radionuclide air effluent emissions are continuously sampled and monitored This is performed in a three-tiered approach and is comprised of SAAMs, TLLα particle screening, and radiochemical analysis of isotopes collected form air duct effluent emission samples. There are approximately 130 emissions samplers in 63 air exhaust ducts within 17 buildings at RFP

- Tritium is the only gaseous radioactive emission material that is routinely monitored at RFP Tritium is monitored at six locations by collecting tritium in water-filled bubbler impingers located in building effluent systems

- Beryllium is the only nonradiological particulate emission from stationary sources monitored at RFP. Volatile organic compound emissions are not monitored by EG&G at RFP. However, VOC emissions are estimated from chemical inventories and quantities used. Emission permit applications have been prepared for 72 specific units at RFP including, but not limited to, paint booths and diesel engines

- RFP participates in an ambient air monitoring program, the RAAMP program, which includes general and OU-specific monitoring programs. The objectives of the RAAMP are to track the dispersion of airborne radioactive materials from RFP into the surrounding environment and communities and to establish baseline concentrations The

CDH Radiation Control Division Surveillance Program monitors ambient air concentrations of gross alpha and gross beta radioactivity in suspended particulate material. In addition, citizen-operated environmental air surveillance stations are operated in the cities of Broomfield, Arvada, Westminster, Northglenn, and Thorton

- Based on environmental investigations at 16 Operable Units at RFP, air monitoring is being developed or is developed for the investigation of these sites Monitoring programs are designed for planned activities, potential exposure pathways, constituents of concern, worker protection, and to measure concentrations leaving the work area

- Both TSP and PM-10 are monitored by RFP at one nonradiological particulate air sampling location This sampling for a broad range particulate size is used as an internal management tool, baseline data record, and cross-comparisons with nonroutine ambient radiological particulate sampling studies

- The RFP Emergency Plan provides respond measures for protection of the health and safety of onsite personnel and the public, limit damage to facilities and equipment, minimize impact to onsite operations and security, and limit adverse impacts on the environment.

8.5 ADDITIONAL DATA COMPILATION, IHSSs 118.1, 118.2, 150.6, 150.8, 151, 172, 184, AND 188

Additional data compilation tasks for the abovementioned IHSSs were identified in the Stage 1 activities in the OU8 Work Plan. The following briefly summarizes the findings of the data compilation activities by IHSS·

118.1 The data compilation task was to identify whether the concrete containment was removed when the 5,000 gallon underground steel storage tank was removed Information regarding this containment is still being sought and is expected to be obtained before the finalization of this document.

118.2 The data compilation task for this IHSS was to determine whether a 5,000 gallon aboveground carbon tetrachloride tank near Building 707 was removed. Based on interviews with knowledgeable personnel, this tank still exists

150.6, 150.8 The data compilation task for these IHSSs consisted of a review of the pavement history before, during, and after a spill of residual waste oil Based on a review of available information, pavement has been removed and replaced many times since the incident. No further investigative activities outside of those recommended in the OU8 Work Plan are recommended for this IHSS

151 An evaluation of the tank inspection records for a 47,500 gallon underground storage tank in this IHSS was performed. Based on a review of records from 1988, 1990, 1991, and 1992, this tank has recently been tested on several occasions. No further pressure testing of this tank is recommended for Stage 2 activities

172 Clarification of the pavement history before, during, and after a spill of radioactive material in this IHSS (Central Avenue) was identified as a Stage 1 activity. Stage 1 activities also include an investigation of the location of the old ditch Based on a review of available information, some pavement sections along Central Avenue have been replaced while other sections are still intact

Therefore, it is recommended that asphalt samples be collected and analyzed for laboratory HPGe.

184 Data compilation for this IHSS includes an investigation of the pavement history for an area of steam cleaning activities near Building 992. Based on a review of available information, the pavement was removed and replaced in 1986 after the steam cleaning activities took place No further investigative activities outside of those recommended in the OU8 Work Plan are recommended for this IHSS.

188 Stage 1 data compilation for this IHSS included an investigation of which heavy metals may have been released from a spill of a 55-gallon steel drum containing nitric and hydrochloric acid near the east gate of Building 374 Based on a review of available information, the heavy metals plutonium, depleted uranium, depleted uranium alloys, silver, aluminum, copper, titanium, beryllium, and trace quantities of iron and other cast metals may have been present Based on this information it is recommended that surficial soil samples collected below pavement be laboratory analyzed for the metals titanium, tritium, and uranium

Approved By

______________________ __/__/__
Director (Date)

______________________ __/__/__
Project Manager (Date)

______________________ __/__/__
Quality Assurance Program Manager (Date)

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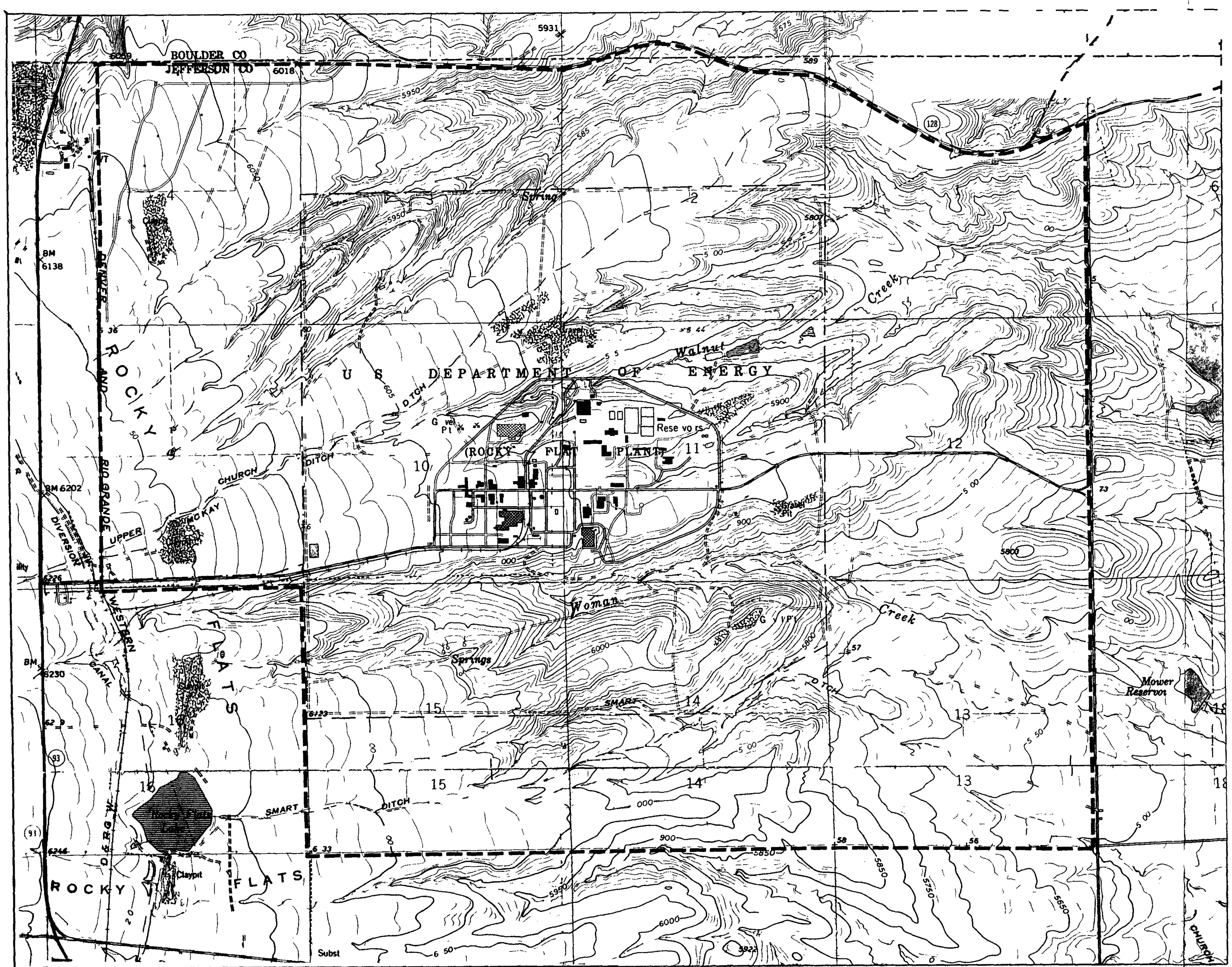

Source: USGS 7 5 Minute Topographic Maps Louisville PR 1979 and Golden PR 1980

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Rocky Flats Plant

EXPLANATION

Rocky Flats Plant Boundary

COLORADO

UTM GRID AND 1979 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

0 07
2 MILS

12½
222 M LS

GN
MN

0 1000 2000 4000
SCALE IN FEET

FIGURE 1
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1
Site Location and
Local Topography

EG&G ROCKY FLATS
Rocky Flats Plant
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Golden CO 80402-0464

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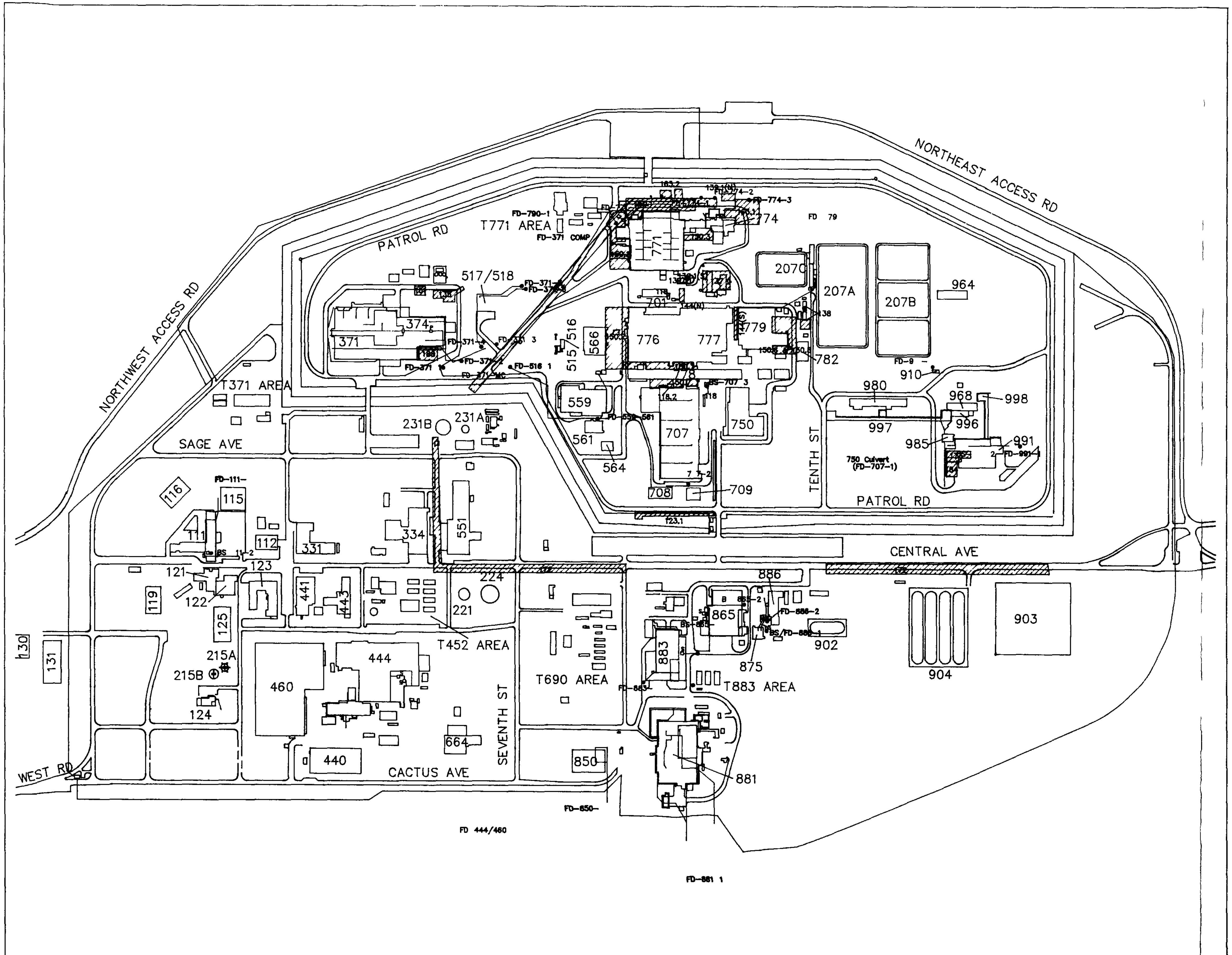

Sample Station (Current)
Sample Station (Historical)
Foundation Drain
Road
Fence
Structure/Building
Sump/Pit
OU8 IHSS
FD Foundation Drain
BS Building Sump

N

0 100 200 300 400 500 FEET

FIGURE 2
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Current and Historical
Foundation Drain and Building Sump
Sampling Stations
and OU8 IHSSs

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C \RFLATS\OU8\FIG2 DWG 05H60208

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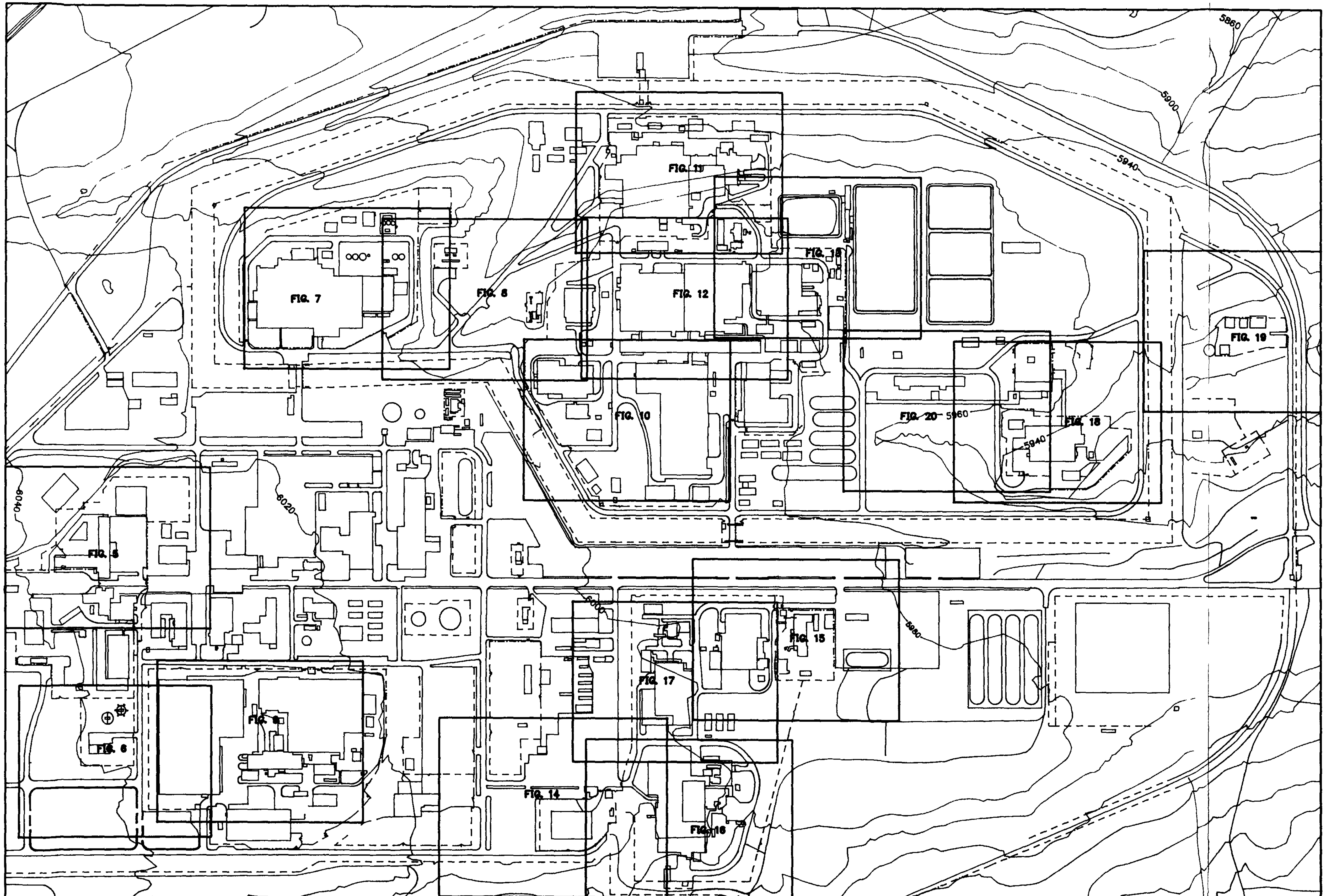

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Rocky Flats Plant

EXPLANATION

FIG. 7 L tl M p I d

St eam D l g

T p g phi C t (C t l terval 20 feet)

B lldi g

Fen

P ved R d

Dit R d

FIGURE 4
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Index Map

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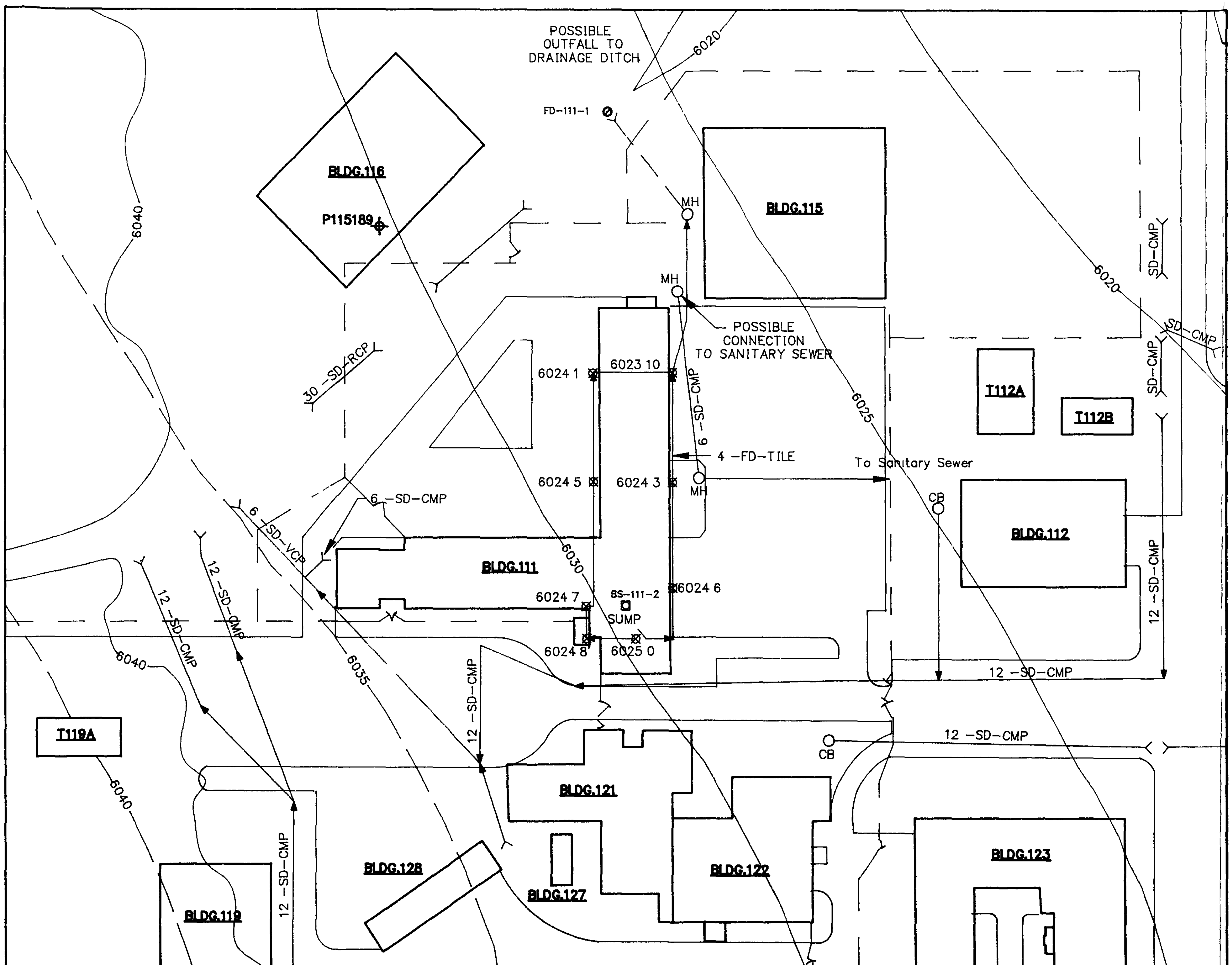

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EXPLANATION DRAFT

- Buildings
- Foundation Drain
- Storm Drain
- Suspected Storm Drain
- Sump

FD Foundation Drain
SD Storm Drain
BS Building Sump
VCP Vitrified Clay Pipe
CMP Corrugated Metal Pipe
RCP Reinforced Concrete Pipe
CB Catch Basin
MH Manhole
Fences
Roads
Ditch

- Elevation Point
- Outfall
- Sample Station (Current)
- Sample Station (Historical)
- Sample Station (Proposed)
- Station Never Sampled
- Alluvial Monitoring Well

5960 Topographic Elevation
5950 Water Table Elevation Spring 1992

0 FEET 50 100 150

FIGURE 5
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Building 111
Foundation Drains Building Sumps and Outfalls

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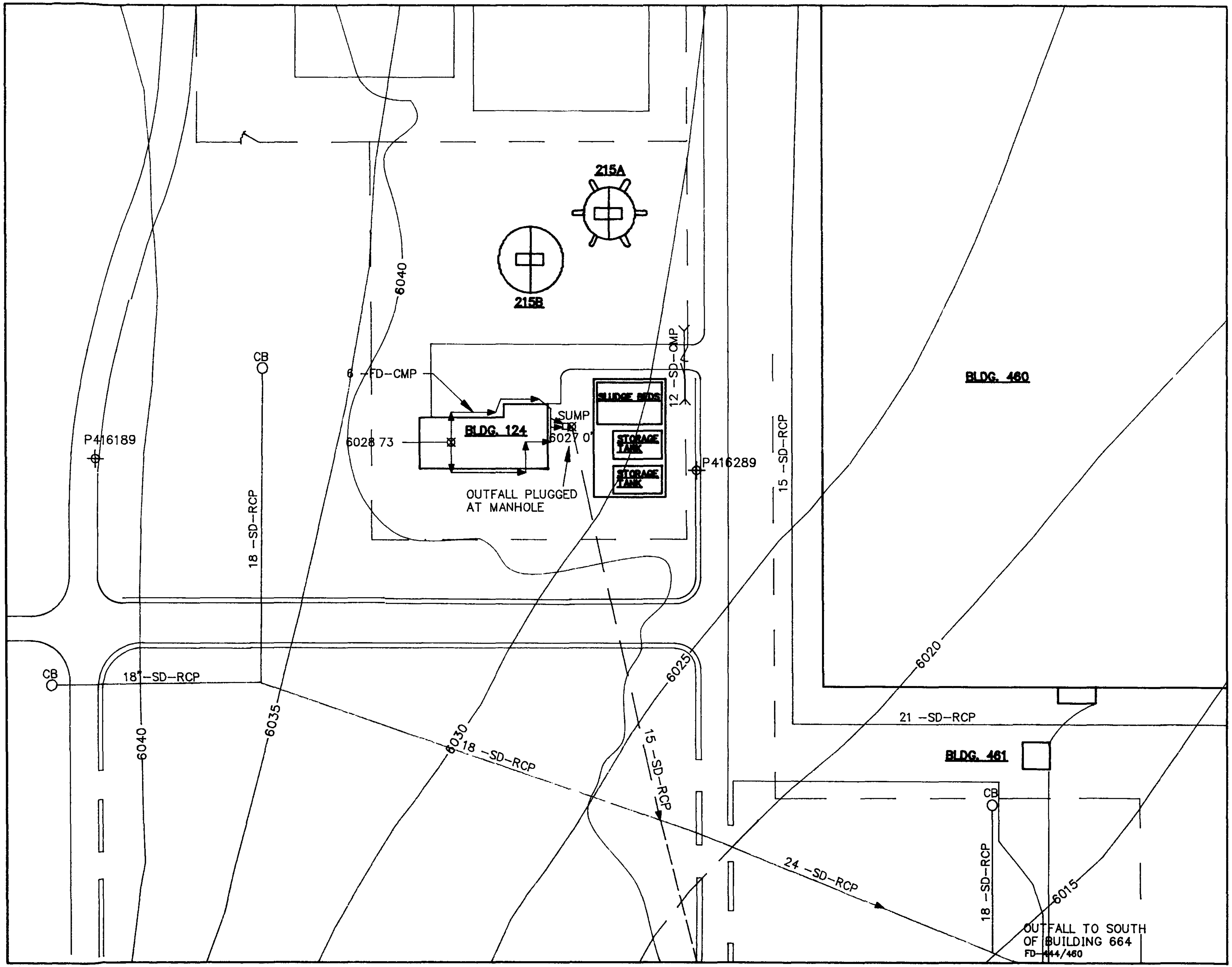

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EXPLANATION DRAFT

- Buildings
- Foundation Drain
- Storm Drain
- Original Drain Location
- Sump
- FD Foundation Drain
- SD Storm Drain
- CMP Corrugated Metal Pipe
- RCP Reinforced Concrete Pipe
- CB Catch Basin
- Fences
- Roads
- Elevation Point
- Outfall
- Sample Station (Current)
- Sample Station (Historical)
- Sample Station (Proposed)
- Station Never Sampled
- Alluvial Monitoring Well
- Bedrock Monitoring Well
- 5960 Topographic Elevation
- 5950 Water Table Elevation Spring 1992

0 FEET 50 100 150

FIGURE 6
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Building 124
Foundation Drains Building
Sumps and Outfalls

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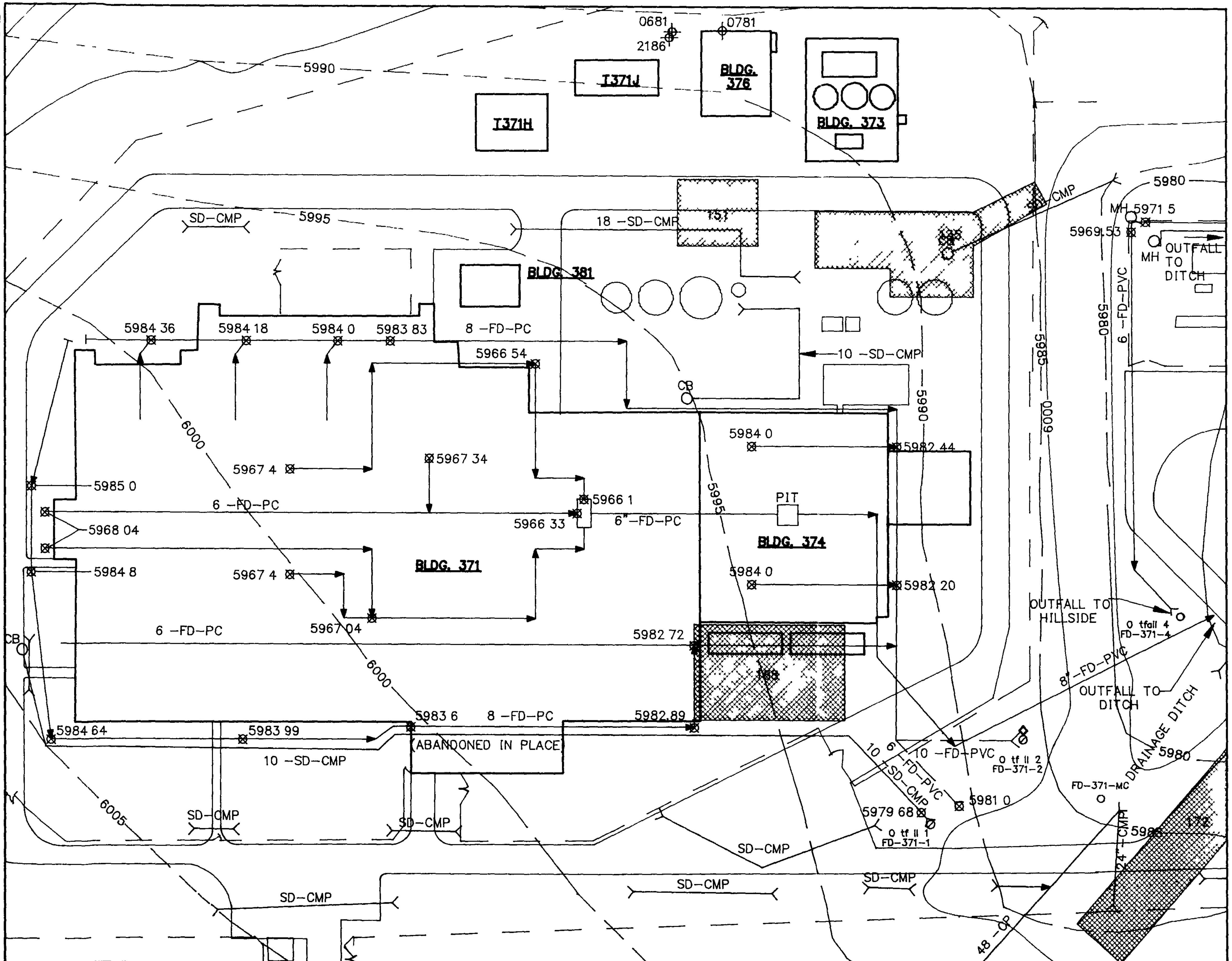

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Rocky Flats Plant

EXPLANATION DRAFT

- Buildings
- Foundation Drain
- Storm Drain
- Possible Foundation Drain
- FD Foundation Drain
- SD Storm Drain
- CMP Corrugated Metal Pipe
- PVC PVC Pipe
- PC Porous Concrete
- CB Catch Basin
- MH Manhole
- Fences
- Roads
- Ditch
- Elevation Point
- Outfall
- Sample Station (Current)
- Sample Station (Historical)
- Sample Station (Proposed)
- Station Never Sampled
- Bedrock Monitoring Well
- 5960 Topographic Elevation
- 5950 Water Table Elevation Spring 1992
- OU8 IHSS

0 FEET 50 100 150

FIGURE 7
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Buildings 371 and 374
Foundation Drains Building
Sumps and Outfalls

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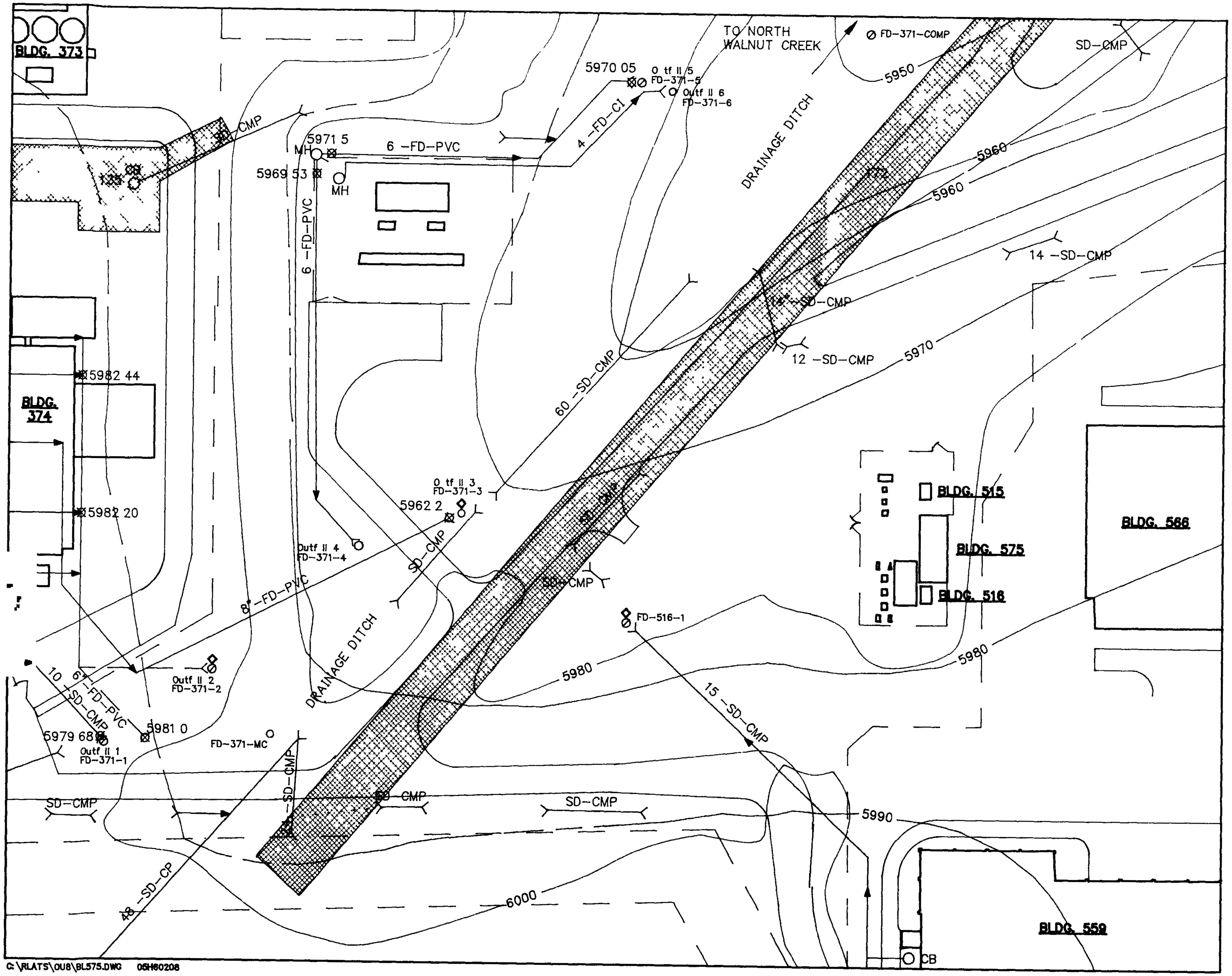

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Rocky Flats Plant

EXPLANATION DRAFT

- Buildings
- Foundation Drain
- Storm Drain
- Possible Foundation Drain
- FD Foundation Drain
- SD Storm Drain
- CMP Corrugated Metal Pipe
- PVC PVC Pipe
- CI Cast Iron
- CP Concrete Pipe
- CB Catch Basin
- Fences
- Roads
- Ditch
- Elevation Point
- Outfall
- Sample Station (Current)
- Sample Station (Historical)
- Sample Station (Proposed)
- Station Never Sampled
- 5960 Topographic Elevation
- 5950 Water Table Elevation Spring 1992
- OU8 IHSS

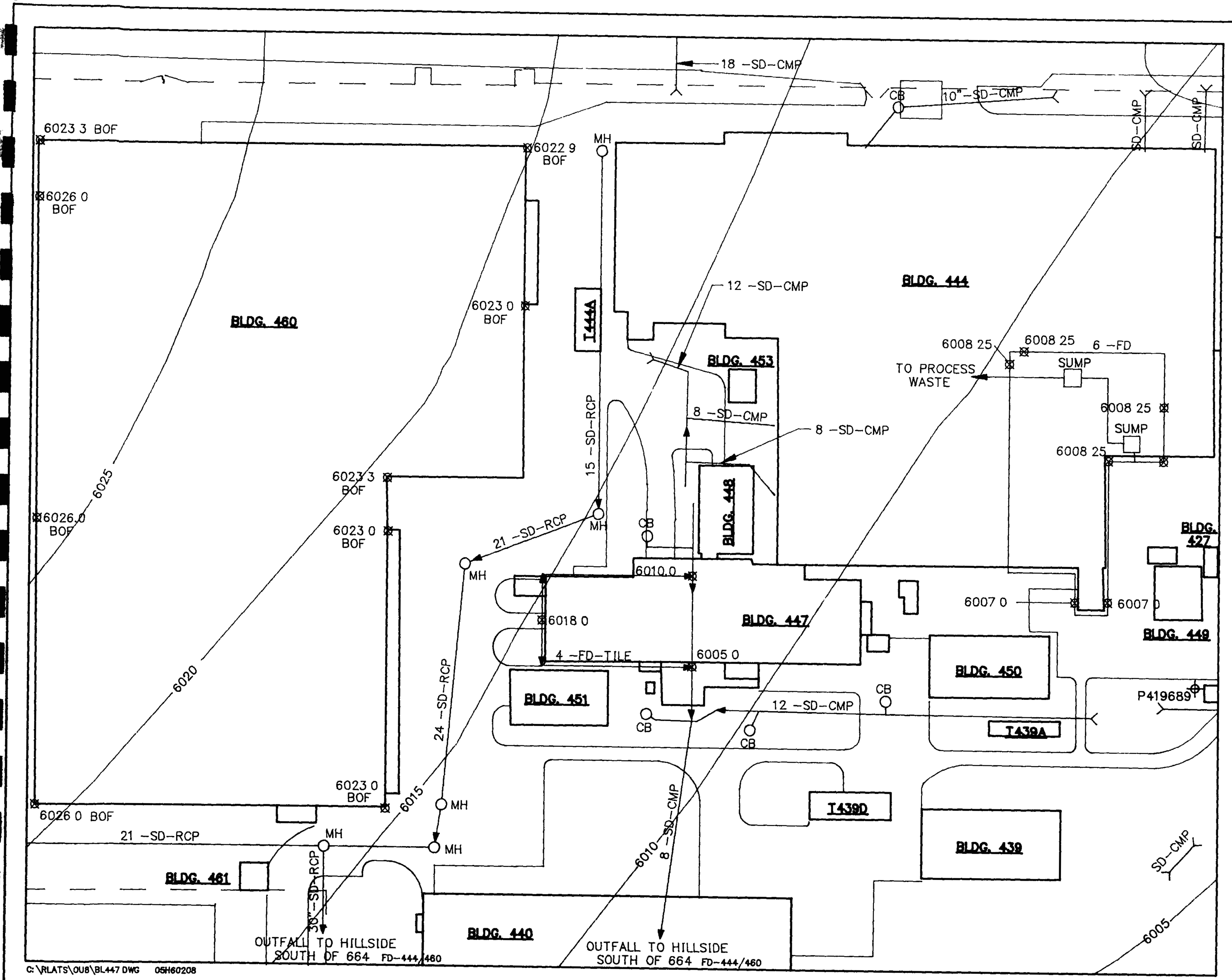
0 FEET 50 100 150

FIGURE 8
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Buildings 559 561 and 374
Foundation Drains Building
Sumps and Outfalls

EG&G ROCKY FLATS

Rocky Flats Plant
P O Box 464
Golden Colorado 80402-0464



U S Department of Energy
Rocky Flats Plant

EXPLANATION DRAFT

Buildings
Foundation Drain
Storm Drain
Sump
FD Foundation Drain
SD Storm Drain
BOF Bottom of Footing
CMP Corrugated Metal Pipe
DIP Ductile Iron Pipe
PVC PVC Pipe
CB Catch Basin
MH Manhole
RCP Reinforced Concrete Pipe
Fences
Roads
Ditch
Elevation Point
Outfall
Sample Station (Current)
Sample Station (Historical)
Sample Station (Proposed)
Station Never Sampled
Alluvial Monitoring Well
5960 Topographic Elevation
5950 Water Table Elevation Spring 1992

0 FEET 50 100 150

FIGURE 9
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Buildings 444 447 and 460
Foundation Drains Building Sumps and Outfalls

EG&G ROCKY FLATS
Rocky Flats Plant
P O Box 464
Golden Colorado 80402-0464

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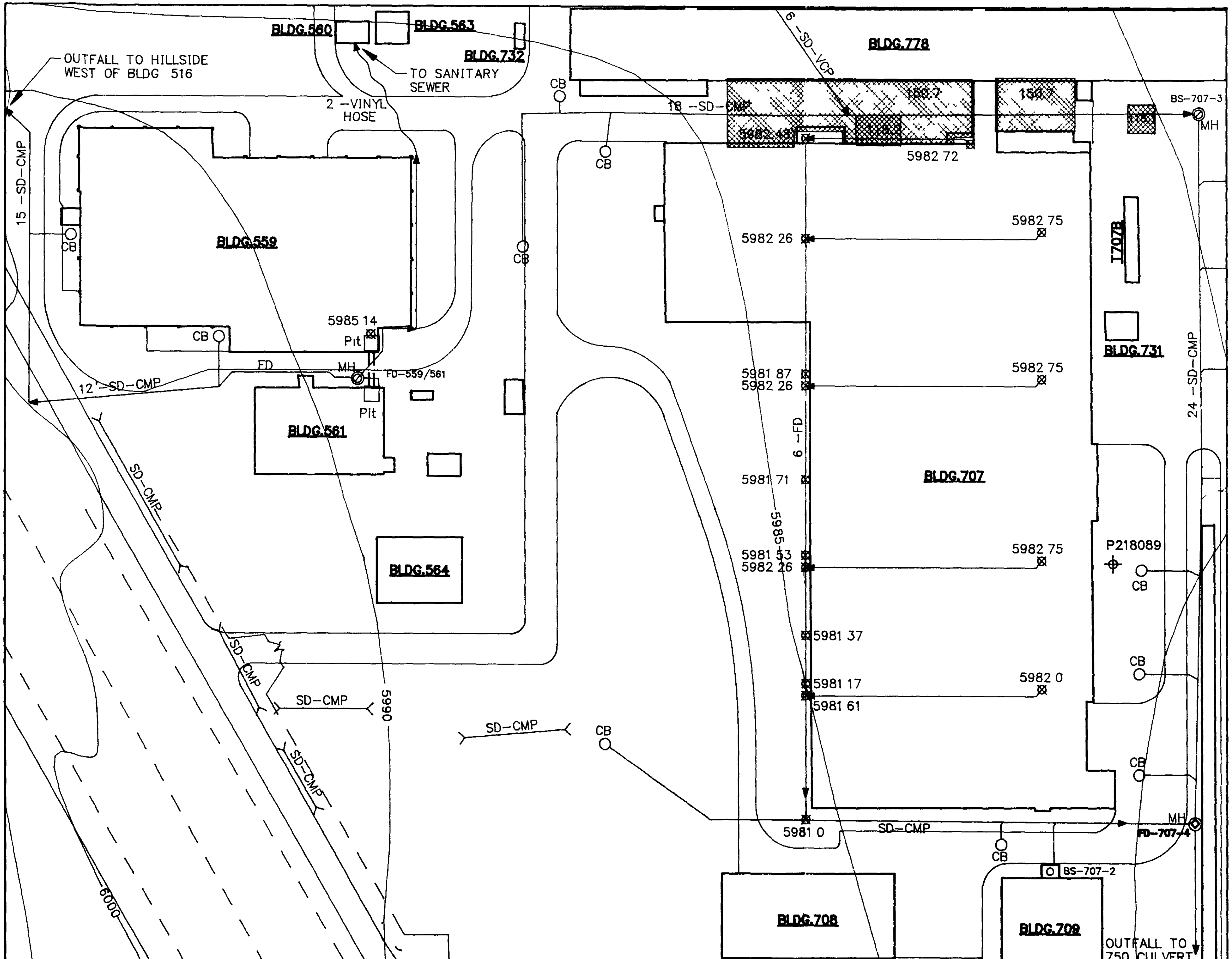

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Rocky Flats Plant

EXPLANATION DRAFT

Buildings
Foundation Drain
Storm Drain
FD Foundation Drain
SD Storm Drain
BS Building Sump
VCP Vitrified Clay Pipe
CMP Corrugated Metal Pipe
CB Catch Basin
MH Manhole
Fences
Roads
Tunnel
Ditch
Elevation Point
Outfall
Sample Station (Current)
Sample Station (Historical)
Sample Station (Proposed)
Station Never Sampled
Alluvial Monitoring Well
5960 Topographic Elevation
5950 Water Table Elevation Spring 1992
OU8 IHSS

0 FEET 50 100 150

FIGURE 10
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Buildings 559 561 and 707
Foundation Drains Building Sumps and Outfalls

EG&G ROCKY FLATS

Rocky Flats Plant
P O Box 464
Golden Colorado 80402-0464

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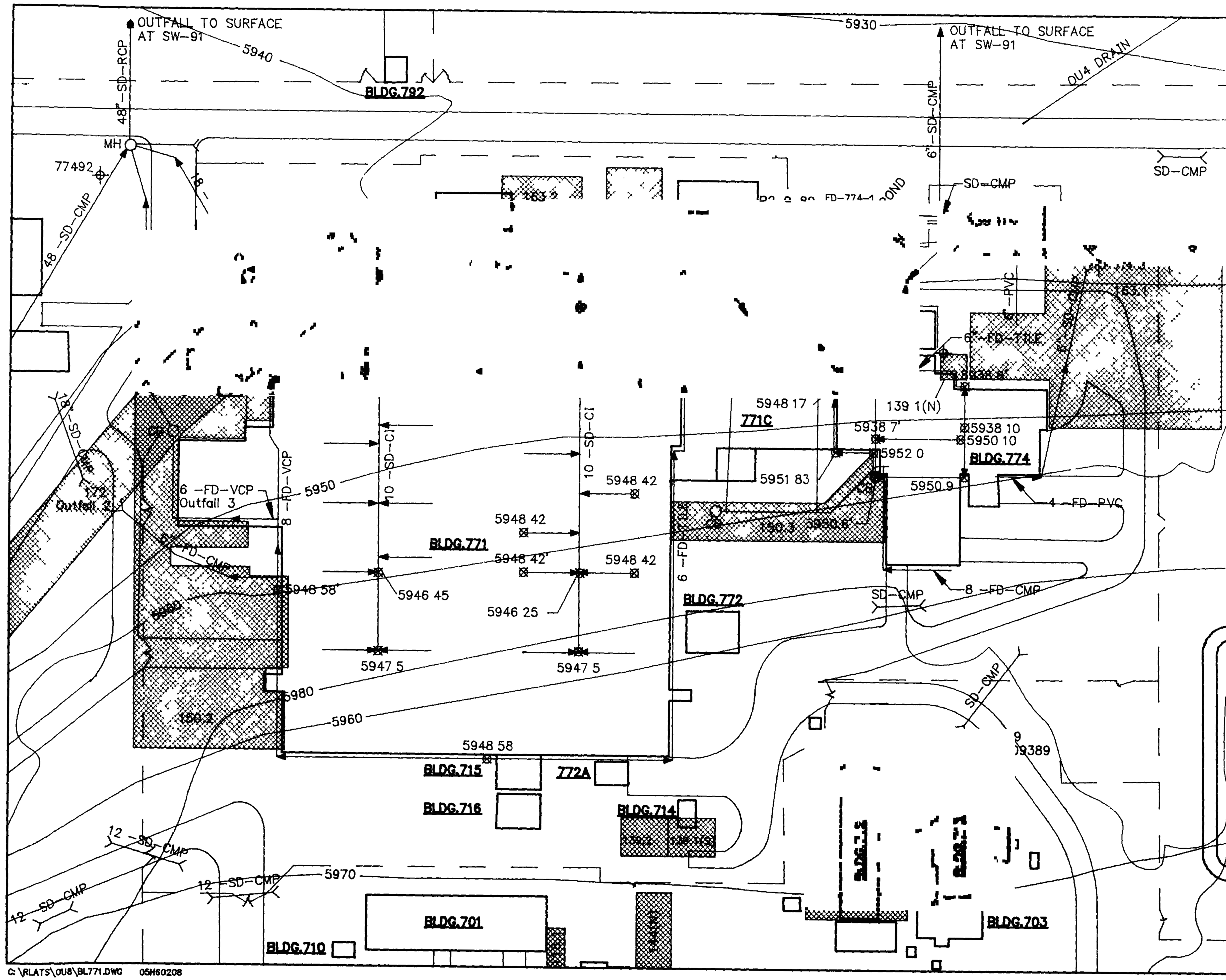

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EXPLANATION DRAFT

Buildings
Foundation Drain
Storm Drain
OU4 Drain
FD Foundation Drain
SD Storm Drain
VCP Vitrified Clay Pipe
CMP Corrugated Metal Pipe
PVC PVC Pipe
RCP Reinforced Concrete Pipe
SW Surface Water Sample Point
CI Cast Iron
CB Catch Basin
MH Manhole
Fences
Roads
Ditch
Elevation Point
Outfall
Sample Station (Current)
Sample Station (Historical)
Sample Station (Proposed)
Station Never Sampled
Alluvial Monitoring Well
Bedrock Monitoring Well
5960 Topographic Elevation
5950 Water Table Elevation Spring 1992
OU8 IHSS

0 FEET 50 100 150

FIGURE 11
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Buildings 771 and 774
Foundation Drains Building Sumps and Outfalls

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Rocky Flats Plant
P O Box 464
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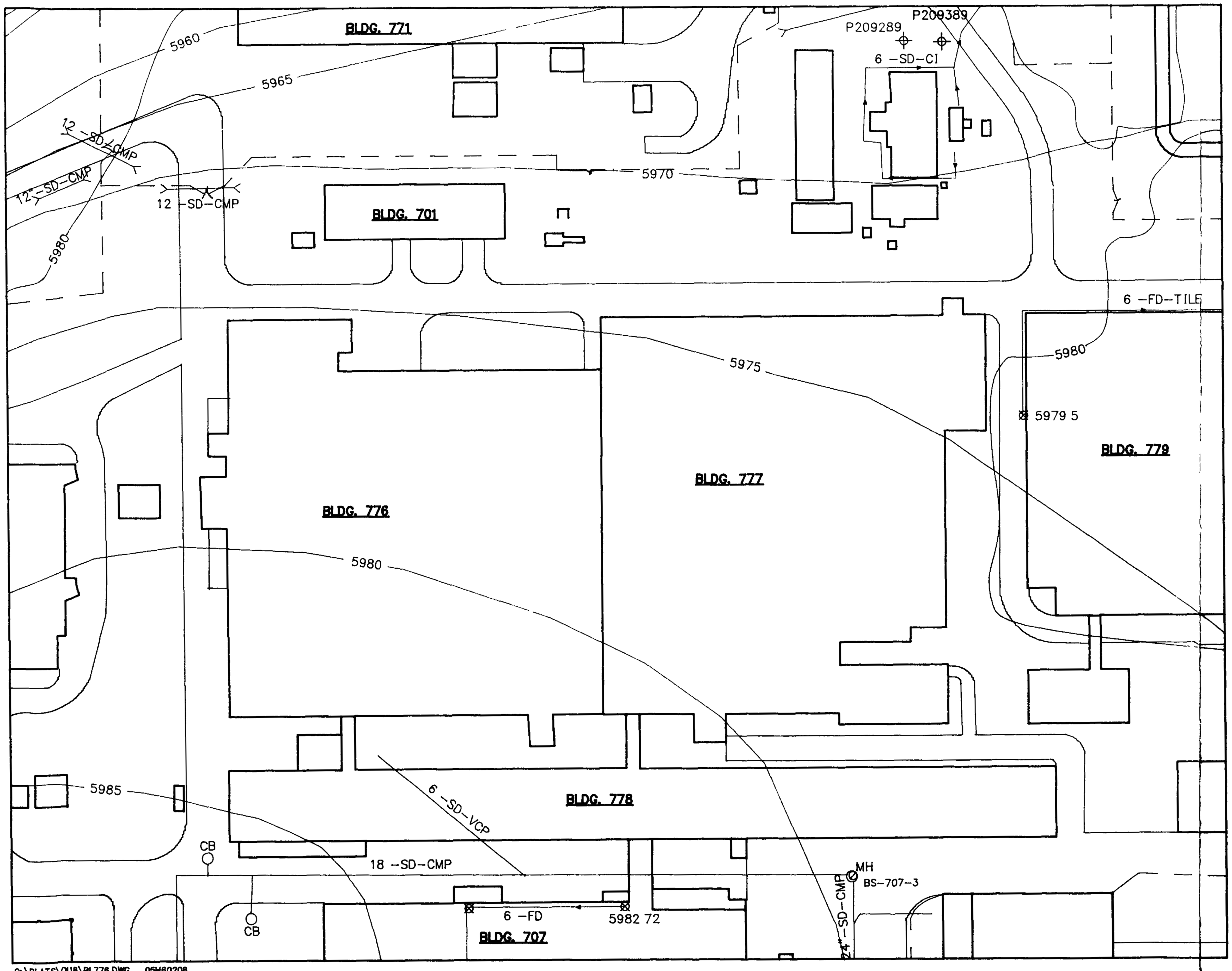

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Rocky Flats Plant

EXPLANATION DRAFT

- Buildings
- Foundation Drain
- Storm Drain
- Suspected Storm Drain
- Sump
- FD Foundation Drain
- SD Storm Drain
- BS Building Sump
- VCP Vitrified Clay Pipe
- CMP Corrugated Metal Pipe
- CI Cast Iron Pipe
- CB Catch Basin
- MH Manhole
- Fences
- Roads
- Ditch
- Elevation Point
- Outfall
- Sample Station (Current)
- Sample Station (Historical)
- Sample Station (Proposed)
- Station never Sampled
- Alluvial Monitoring Well
- Bedrock Monitoring Well
- 5960 Topographic Elevation
- 5950 Water Table Elevation Spring 1992

0 FEET 50 100 150

FIGURE 12
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Buildings 776 777 and 778 Foundation Drains Building Sumps and Outfalls

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Rocky Flats Plant
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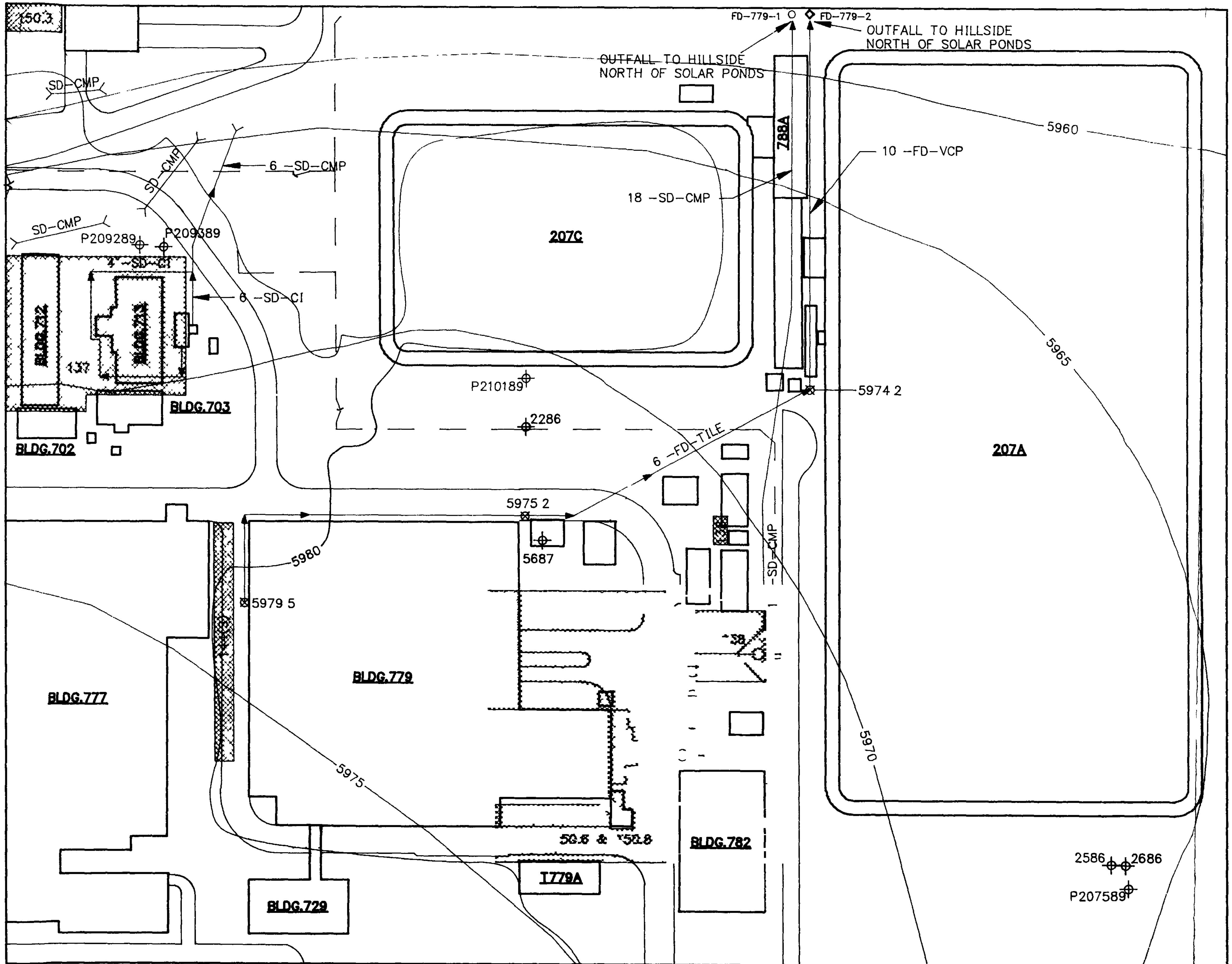

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Rocky Flats Plant

EXPLANATION DRAFT

- Buildings
- Foundation Drain
- Storm Drain
- FD Foundation Drain
- SD Storm Drain
- VCP Vitrified Clay Pipe
- CMP Corrugated Metal Pipe
- CI Cast Iron
- CB Catch Basin
- Fences
- Roads
- Ditch
- Elevation Point
- Outfall
- Sample Station (Current)
- Sample Station (Historical)
- Sample Station (Proposed)
- Station Never Sampled
- Alluvial Monitoring Well
- Bedrock Monitoring Well
- 5960 Topographic Elevation
- 5950 Water Table Elevation Spring 1992
- OU8 IHSS

0 FEET 50 100 150

FIGURE 13
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Building 779
Foundation Drains Building
Sumps and Outfalls

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Rocky Flats Plant
P O Box 464
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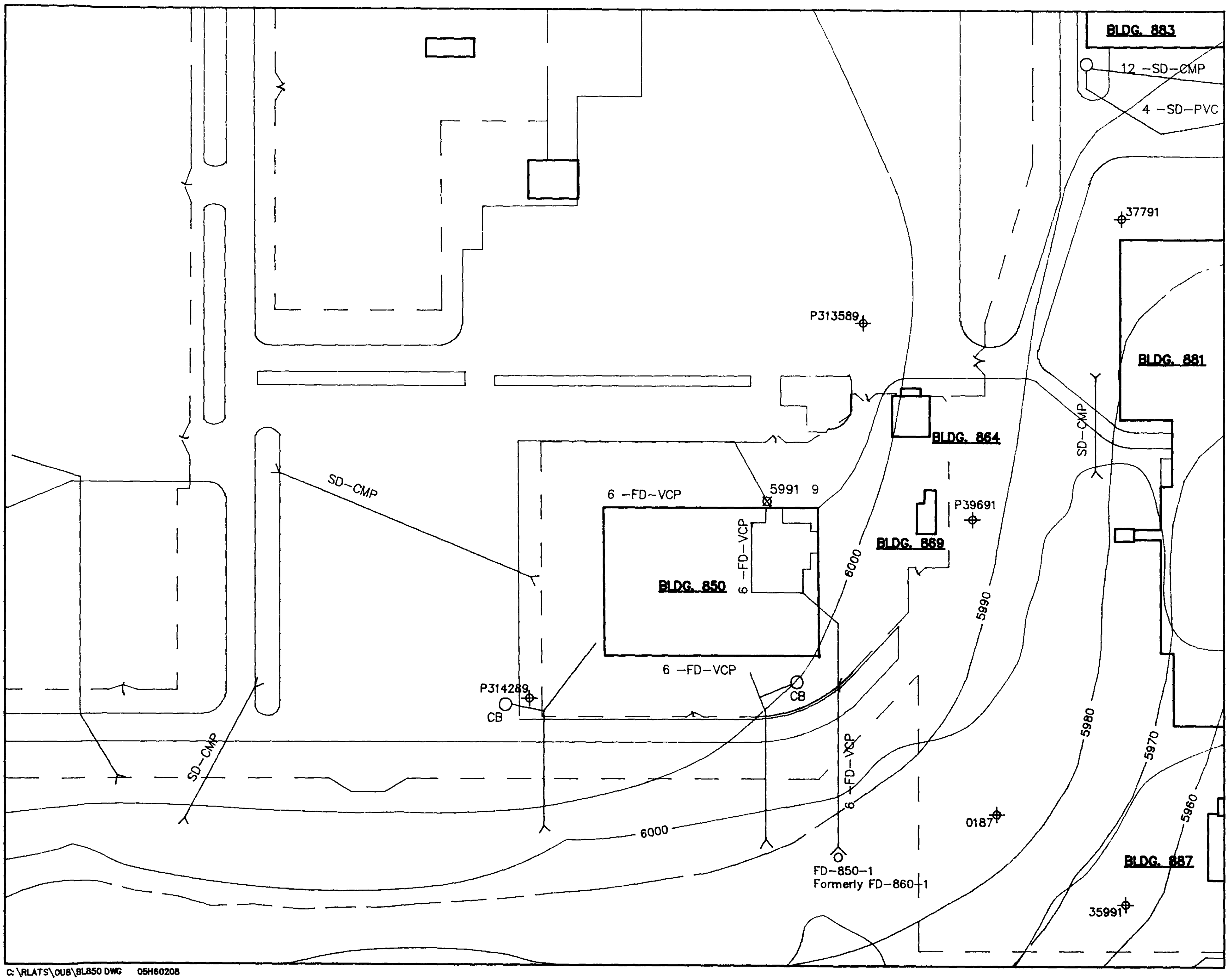

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Rocky Flats Plant

EXPLANATION DRAFT

- Buildings
- Foundation Drain
- Storm Drain
- FD Foundation Drain
- SD Storm Drain
- VCP Vitrified Clay Pipe
- CMP Corrugated Metal Pipe
- PVC PVC Pipe
- CB Catch Basin
- Fences
- Roads
- Ditch
- Elevation Point
- Outfall
- Sample Station (Current)
- Sample Station (Historical)
- Sample Station (Proposed)
- Station Never Sampled
- Alluvial Monitoring Well
- Bedrock Monitoring Well
- 5960 Topographic Elevation
- 5950 Water Table Elevation Spring 1992

0 FEET 50 100 150

FIGURE 14
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Building 850
Foundation Drains Building Sumps and Outfalls

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Rocky Flats Plant
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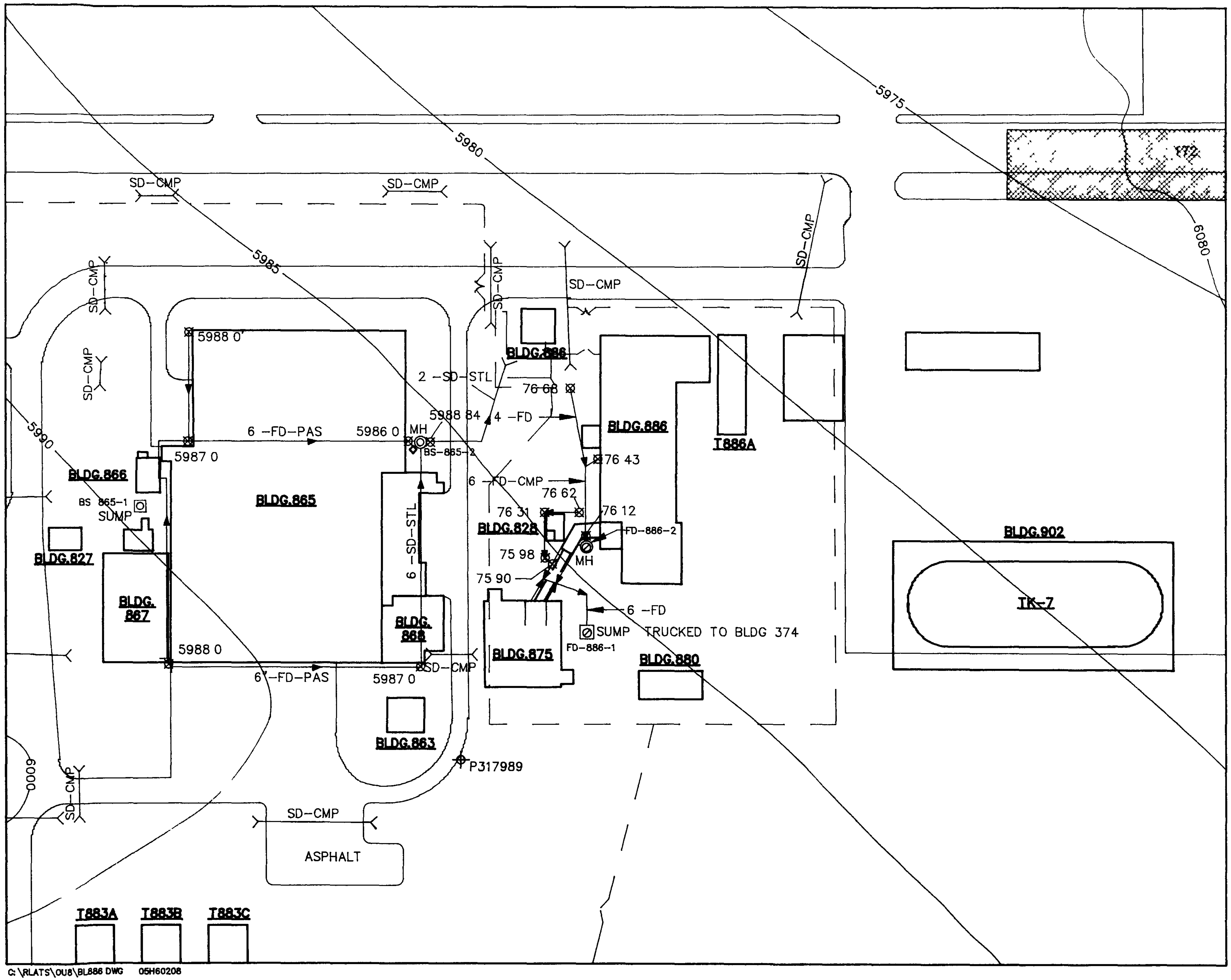

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EXPLANATION DRAFT

- Buildings
- Foundation Drain
- Storm Drain
- Sump
- FD Foundation Drain
- SD Storm Drain
- BS Building Sump
- CMP Corrugated Metal Pipe
- STL Steel
- PAS Perforated Asbestos Subdrain
- MH Manhole
- Fences
- Tunnel
- Roads
- Ditch
- Elevation Point
- Outfall
- Sample Station (Current)
- Sample Station (Historical)
- Sample Station (Proposed)
- Station Never Sampled
- Alluvial Monitoring Well
- Bedrock Monitoring Well
- 5960 Topographic Elevation
- 5950 Water Table Elevation Spring 1992
- OU8 IHSS

0 FEET 50 100 150

FIGURE 15
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Buildings 865 and 886
Foundation Drains Building
Sumps and Outfalls

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Rocky Flats Plant
P O Box 464
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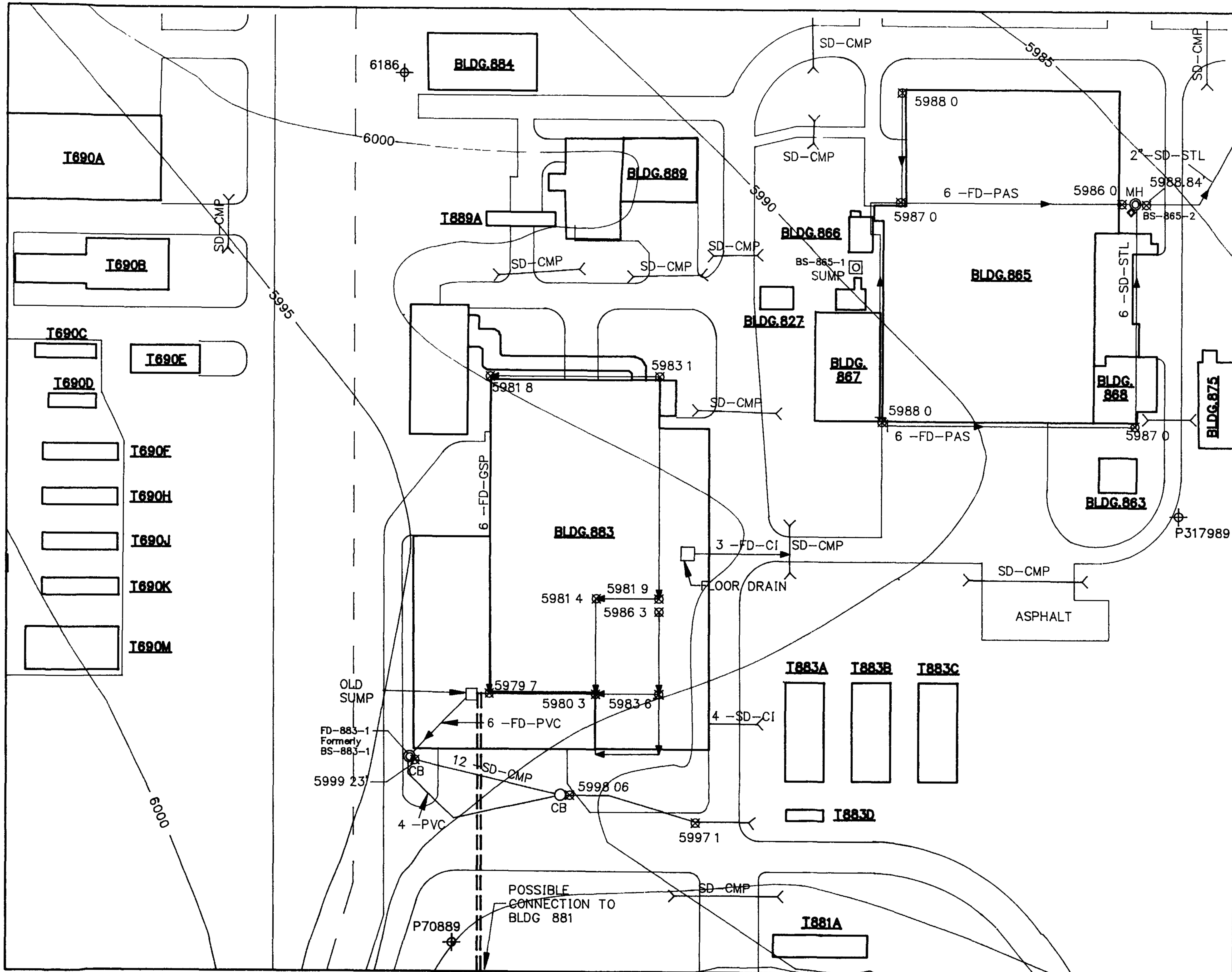

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EXPLANATION DRAFT

- Buildings
- Foundation Drain
- Storm Drain
- Sump

FD Foundation Drain
SD Storm Drain
CMP Corrugated Metal Pipe
PVC PVC Pipe
PAS Perforated Asbestos Subdrain
CI Cast Iron
MH Manhole

- Fences
- Roads
- Tunnel
- Ditch
- Elevation Point
- Outfall
- Sample Station (Current)
- Sample Station (Historical)
- Sample Station (Proposed)
- Station Never Sampled
- Alluvial Monitoring Well
- Bedrock Monitoring Well

5960 Topographic Elevation
5950 Water Table Elevation Spring 1992

0 FEET 50 100 150

FIGURE 17
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Building 883
Foundation Drains Building Sumps and Outfalls

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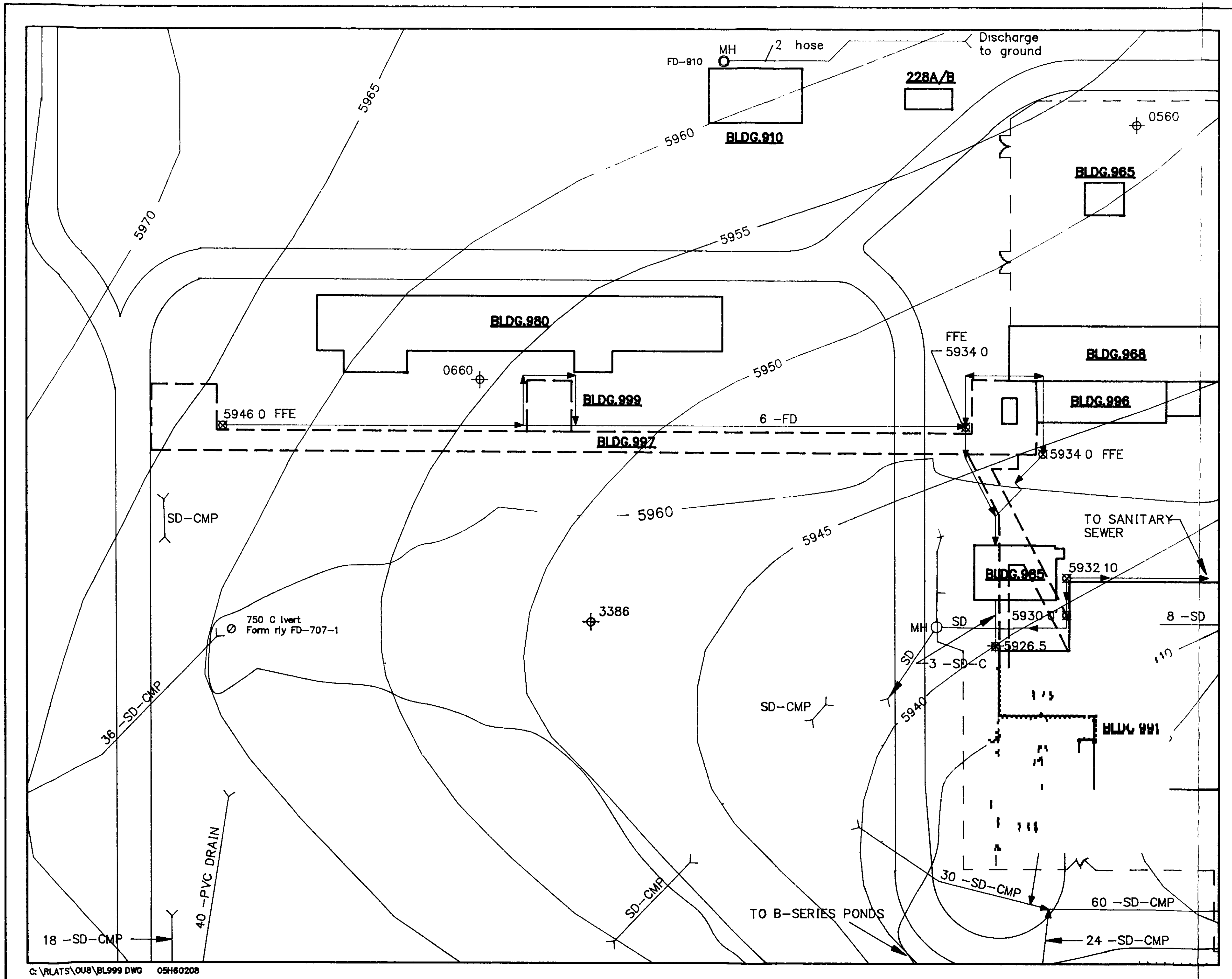

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EXPLANATION DRAFT

- Buildings
- Underground Structures
- Foundation Drain
- Storm Drain
- Old Foundation Drain
- Sump
- FD Foundation Drain
- SD Storm Drain
- CMP Corrugated Metal Pipe
- PVC PVC Pipe
- FFE Finished Floor Elevation
- CI Cast Iron
- MH Manhole
- Fences
- Roads
- Tunnel
- Ditch
- Elevation Point
- Outfall
- Sample Station (Current)
- Sample Station (Historical)
- Sample Station (Proposed)
- Station Never Sampled
- Alluvial Monitoring Well
- Bedrock Monitoring Well
- 5960 Topographic Elevation
- 5950 Water Table Elevation Spring 1992
- OU8 IHSS

0 FEET 50 100 150

FIGURE 18
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Buildings 910 996 997 and 999
Foundation Drains Building
Sumps and Outfalls

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Rocky Flats Plant
P O Box 464
Golden Colorado 80402-0464

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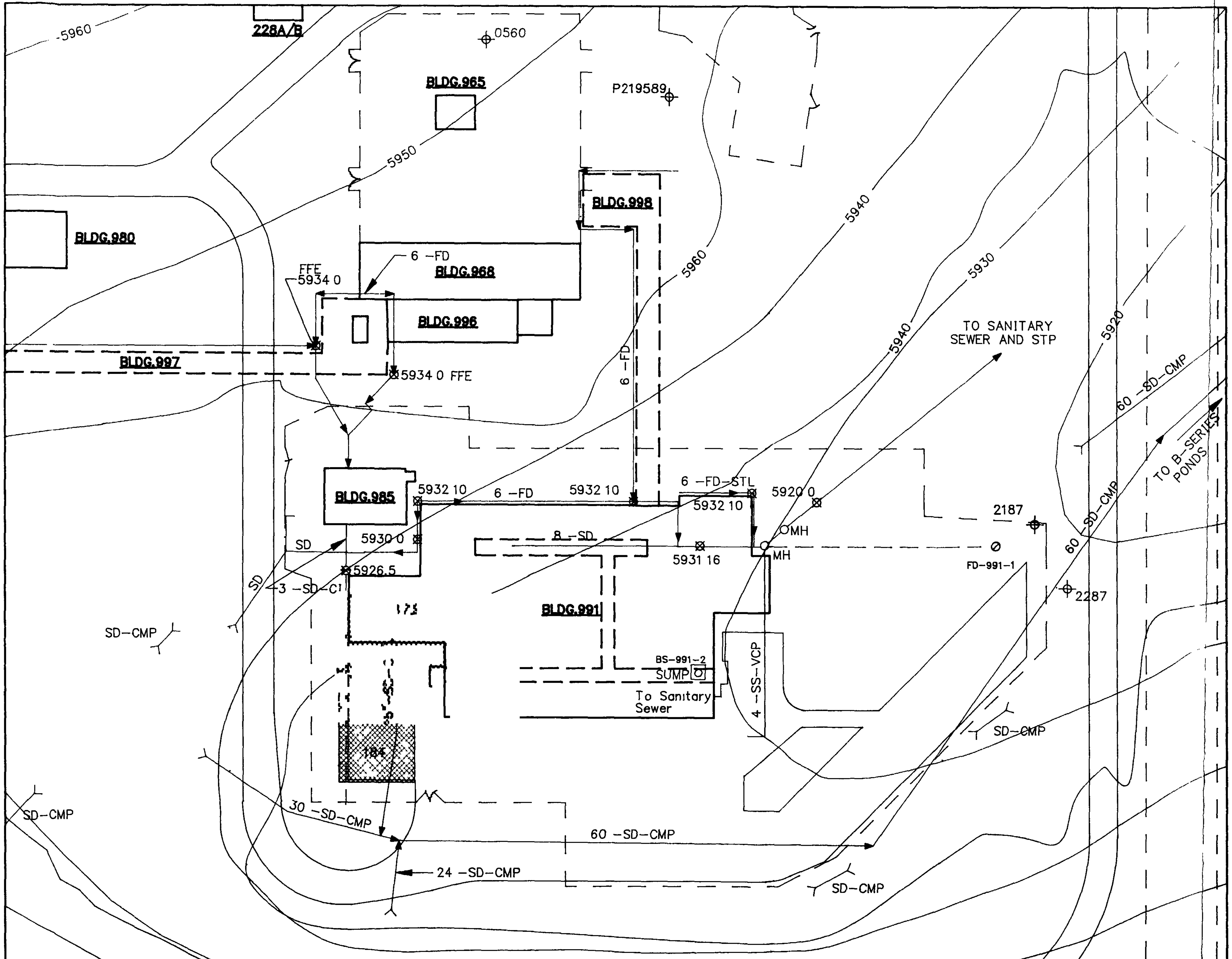

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Rocky Flats Plant

EXPLANATION DRAFT

- Buildings
- Underground Structures
- Foundation Drain
- Storm Drain
- Old Foundation Drain
- Sump
- FD Foundation Drain
- SD Storm Drain
- VCP Vitrified Clay Pipe
- CMP Corrugated Metal Pipe
- PVC PVC Pipe
- CI Cast Iron
- STL Steel
- FFE Finished Floor Elevation
- MH Manhole
- Fences
- Roads
- Tunnel
- Ditch
- Elevation Point
- Outfall
- Sample Station (Current)
- Sample Station (Historical)
- Sample Station (Proposed)
- Station Never Sampled
- Alluvial Monitoring Well
- Bedrock Monitoring Well
- 5960 Topographic Elevation
- 5950 Water Table Elevation Spring 1992
- OU8 IHSS

0 FEET 50 100 150

FIGURE 19
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Buildings 991 and 998
Foundation Drains Building
Sumps and Outfalls

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Rocky Flats Plant
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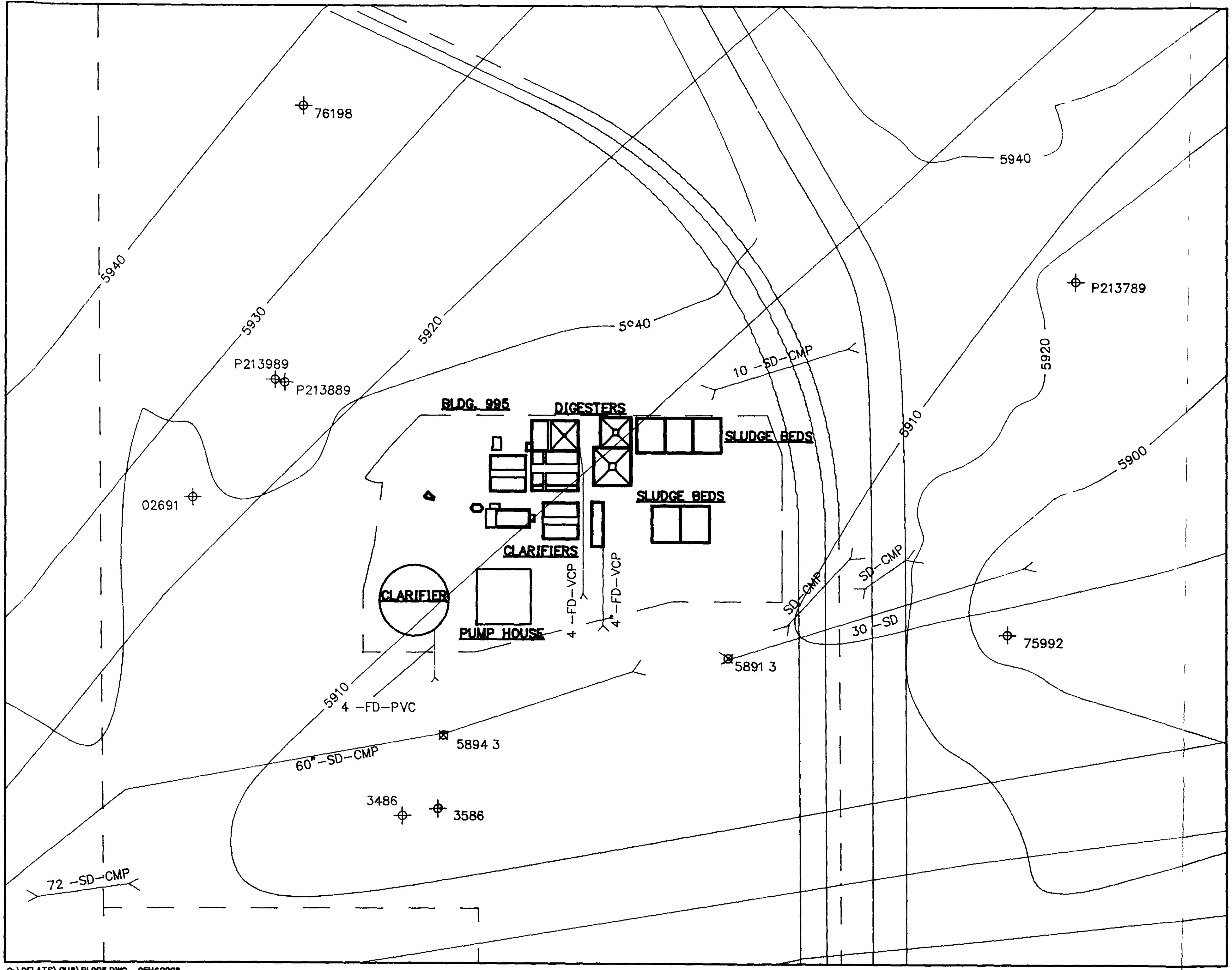

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Rocky Flats Plant

EXPLANATION DRAFT

- Buildings
- Foundation Drain
- Storm Drain
- FD Foundation Drain
- SD Storm Drain
- VCP Vitrified Clay Pipe
- CMP Corrugated Metal Pipe
- PVC PVC Pipe
- Fences
- Roads
- Ditch
- Elevation Point
- Outfall
- Sample Station (Current)
- Sample Station (Historical)
- Sample Station (Proposed)
- Station never Sampled
- Alluvial Monitoring Well
- Bedrock Monitoring Well
- 5960 Topographic Elevation
- 5950 Water Table Elevation Spring 1992

0 FEET 50 100 150

FIGURE 20
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Building 995
Foundation Drains Building Sumps and Outfalls

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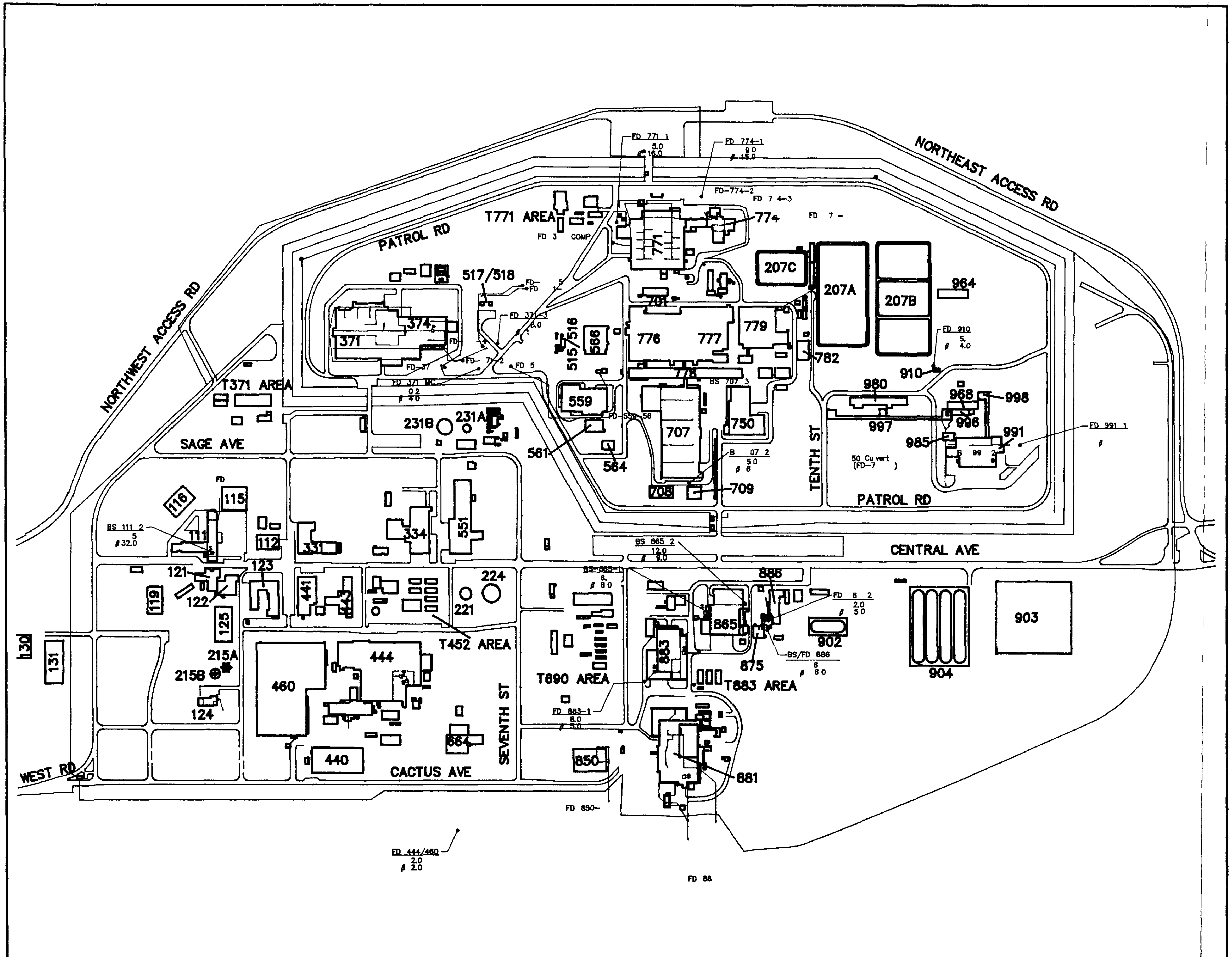

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Rocky Flats Plant

EXPLANATION

DRAFT

- Buildings
- Foundation Drain
- Sump
- FD Foundation Drain
- BS Building Sump
- — — Fences
- —— Roads
- Outfall/Sample Location

All units in picocuries per liter

FIGURE 21
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1
Foundation Drain and Building Sump
Analytical Results
March – April 1993
Radionuclides

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P O Box 464
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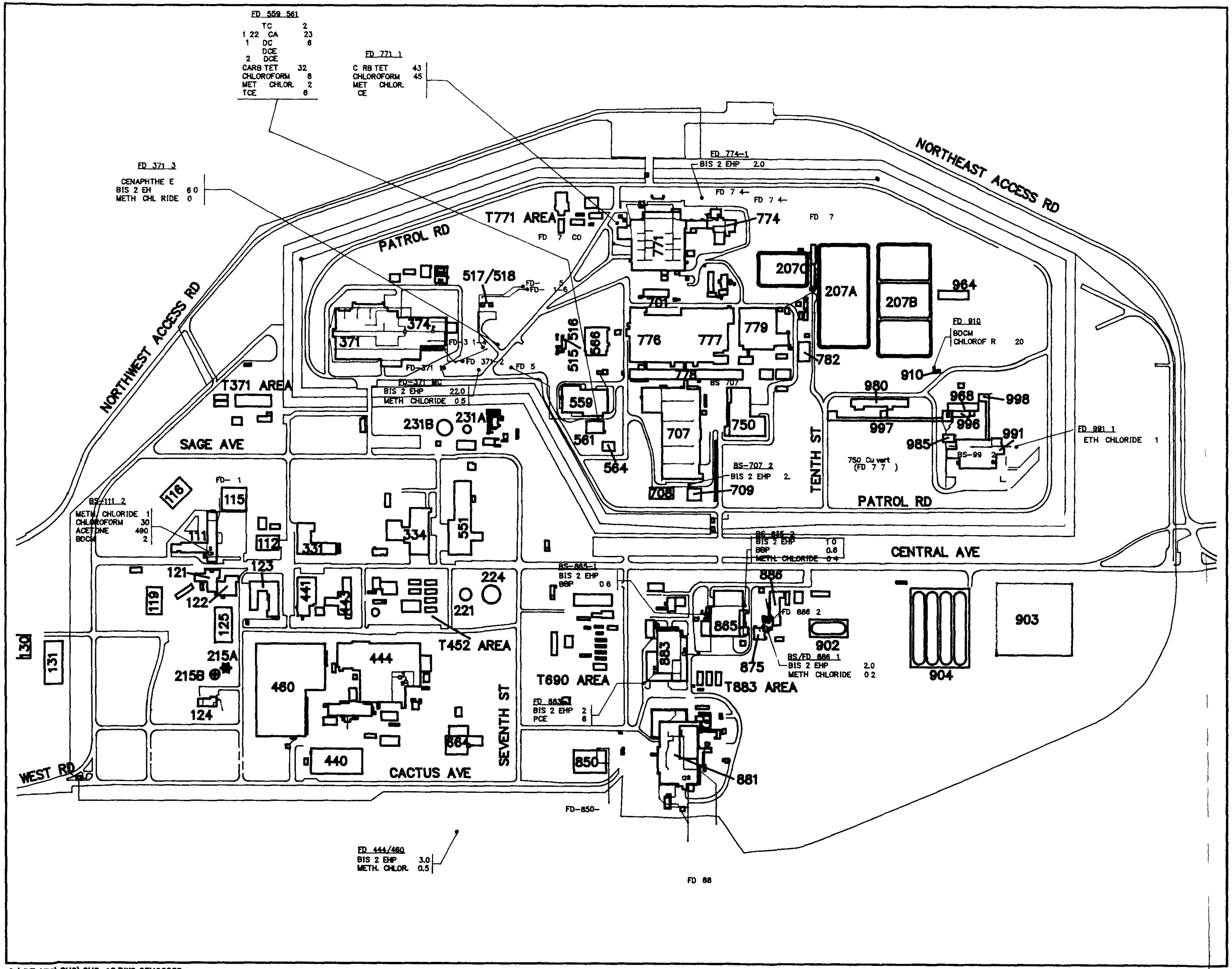

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Rocky Flats Plant

EXPLANATION

DRAFT

- Buildings
- Foundation Drain
- Sump
- FD Foundation Drain
- BS Building Sump
- — — Fences
- —— Roads
- Outfall/Sampling Location

All units in micrograms per liter

0 100 200 300 400 500 FEET

FIGURE 22
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Foundation Drain and Building Sump
Analytical Results
March – April 1993
Volatile and Semivolatile
Organic Compounds

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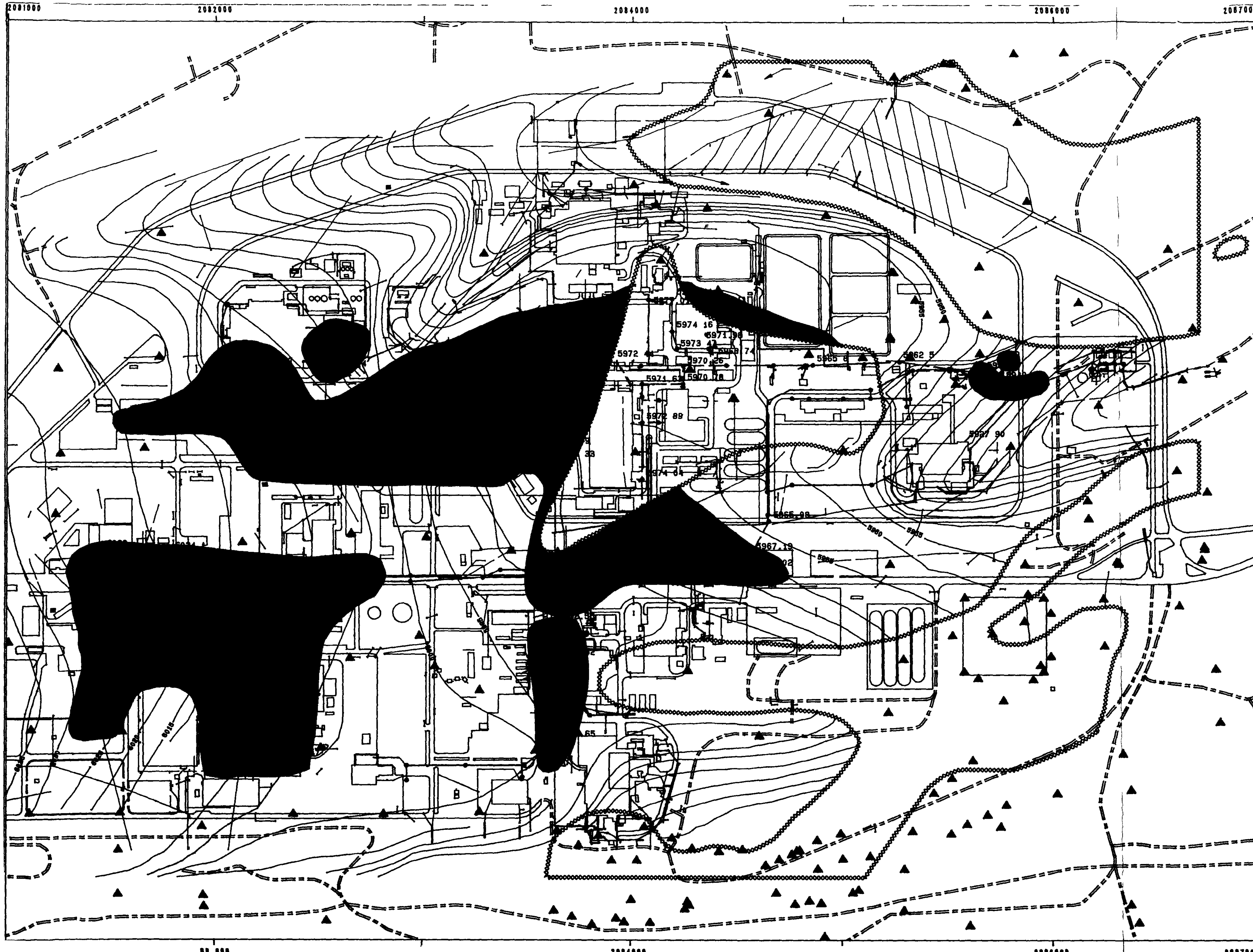

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Rocky Flats Plant

Figure 53

Rocky Flats Plant

Storm and Sanitary Sewer

Infiltration/Exfiltration

Fall 1992

- *Fall Water Table Elevations Dashed where Inferred*
- *Unsaturated Zone (Alluvium)*
- *Sewer system with invert elevations for manholes*
- *Storm sewer drainage system*
- *Zone of Potential Exfiltration From Sanitary Sewer System*
- *Zone of Potential Infiltration To Sanitary Sewer System*
- *Paved Roads*
- *Dirt Roads*

▲ *Alluvial Ground Water Wells*

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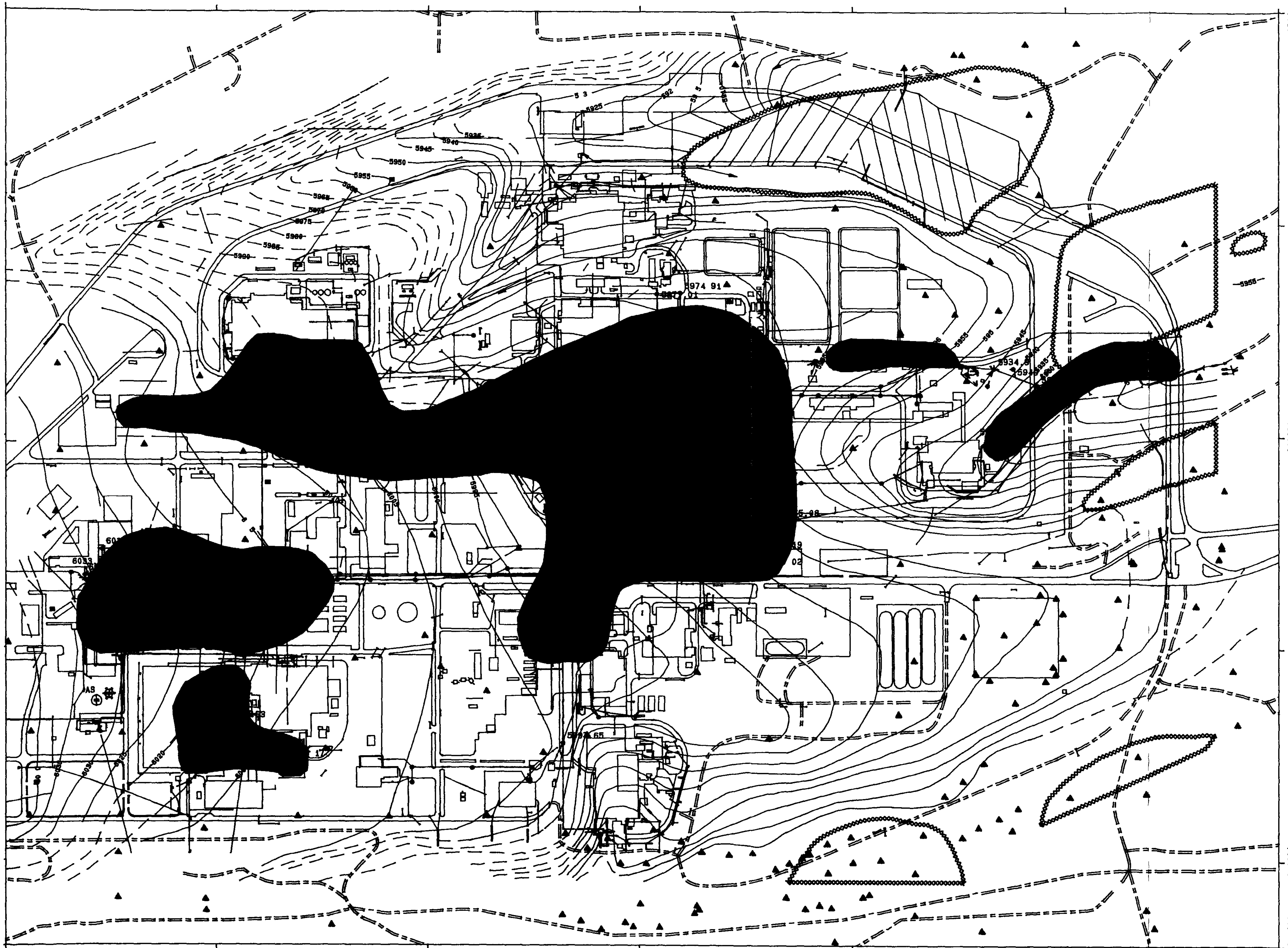

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Rocky Flats Plant

Figure 54

Rocky Flats Plant

Storm and Sanitary Sewer

Infiltration/Exfiltration

Spring 1992

Spring Water Table Elevations Dashed where Inferred

Unsaturated Zone (Alluvium)

Sewer system with invert elevations for manholes

Storm sewer drainage system

Zone of Potential Exfiltration From Sanitary Sewer System

Zone of Potential Infiltration To Sanitary Sewer System

Paved Roads

Dirt Roads

▲ *Alluvial Ground Water Wells*

Prepared by

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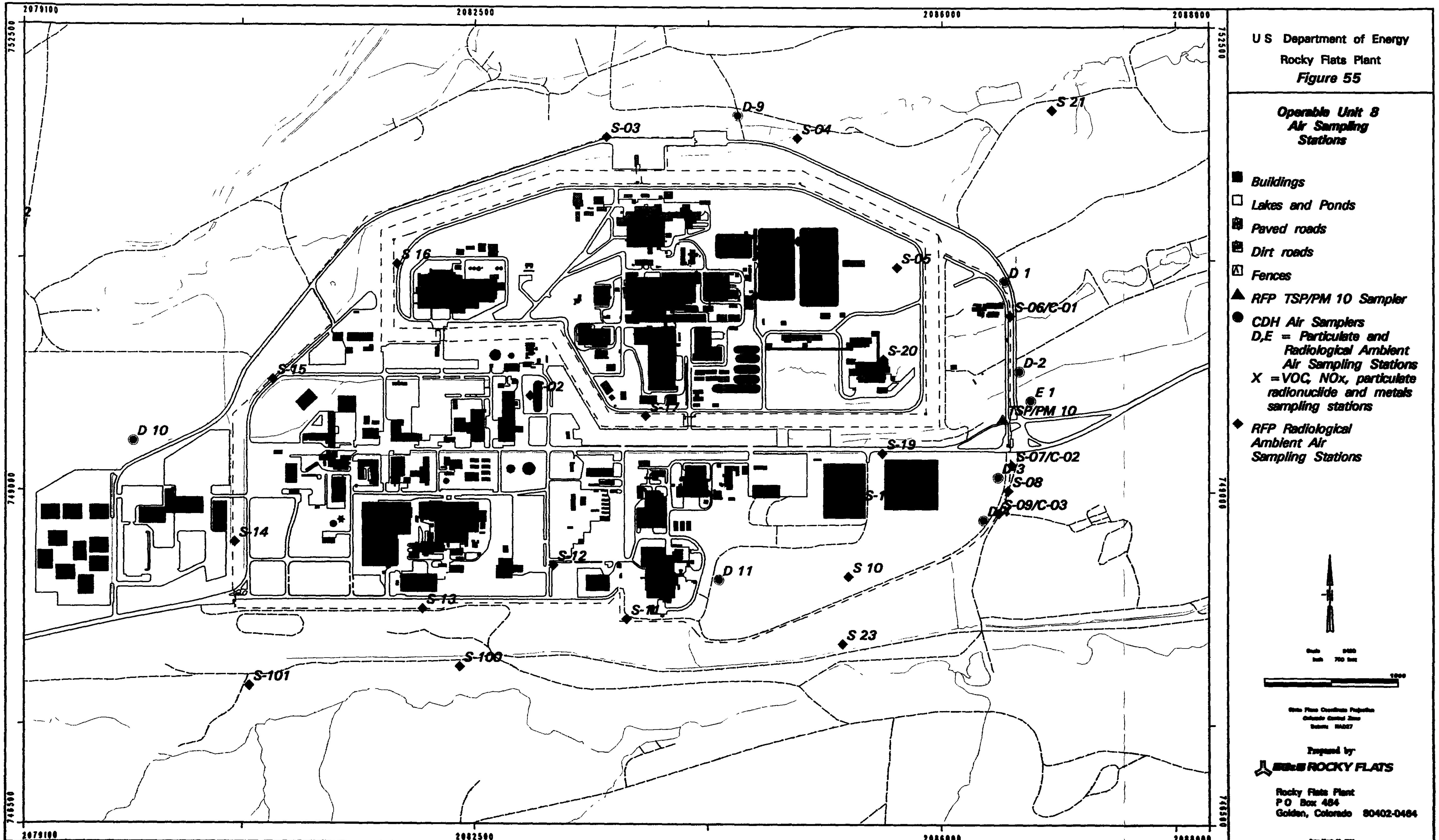

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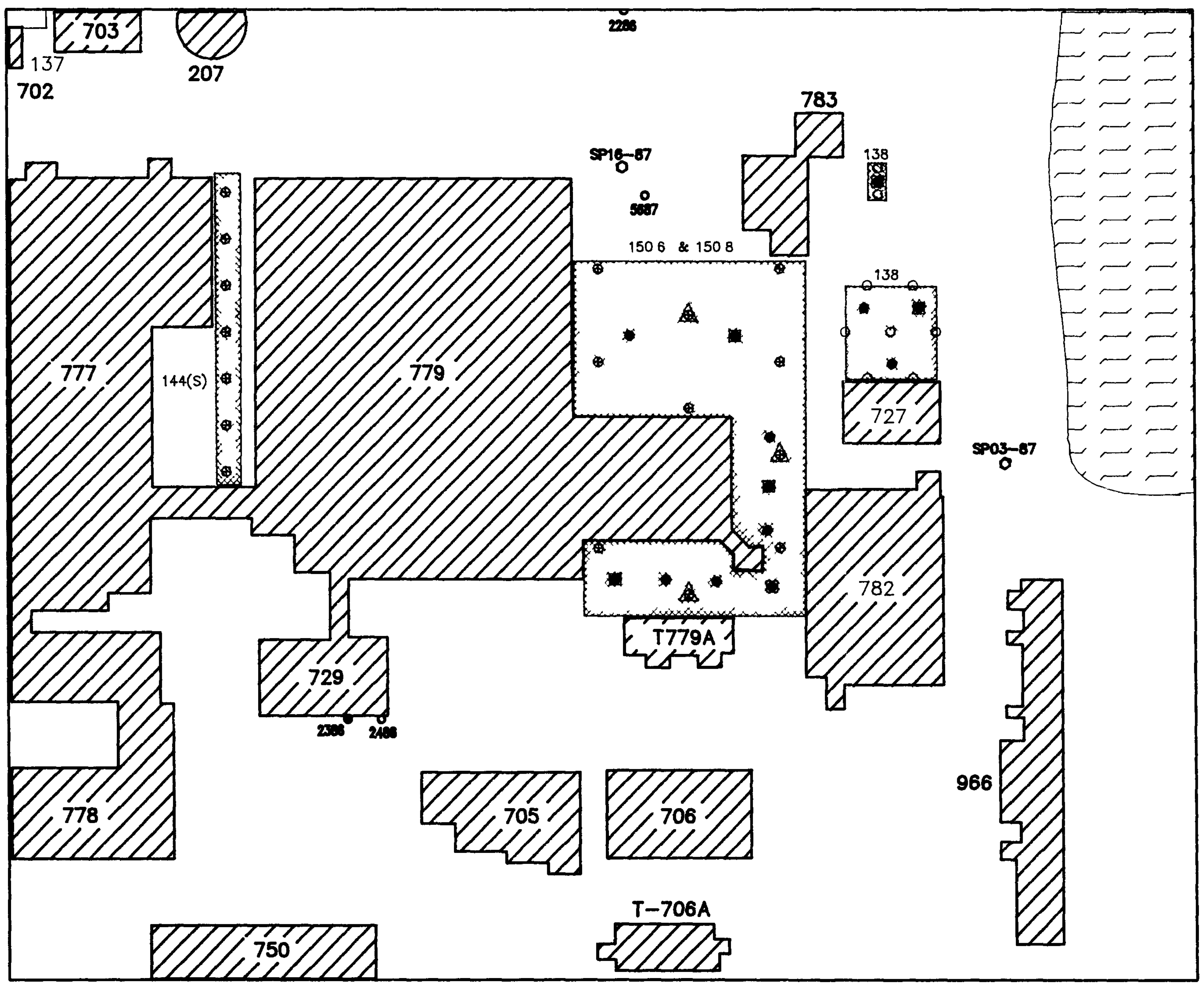
Rocky Flats Plant
Figure 55
Operable Unit 8
Air Sampling
Stations
Buildings
Lakes and Ponds
Paved roads
Dirt roads
Fences
RFP TSP/PM 10 Sampler
CDH Air Samplers
D,E = Particulate and Radiological Ambient Air Sampling Stations
X = VOC, NOx, particulate radionuclide and metals sampling stations
RFP Radiological Ambient Air Sampling Stations
Prepared by
ROCKY FLATS
Rocky Flats Plant
P O Box 464
Golden, Colorado 80402-0464
2079100
2082500
2086000
2088000
752500
749000
745500
D-9
S-03
S-04
S 21
S 16
S-05
D 1
S-06/C-01
S-20
D-2
E 1
TSP/PM 10
S-15
D 10
S-19
S-07/C-02
S-08
S-09/C-03
S-14
S-12
D 11
S 10
S-13
S 23
S-100
S-101



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Rocky Flats Plant

EXPLANATION DRAFT

Buildings
Water Features
Individual Hazardous Substance Sites
Roads

EXISTING SAMPLING LOCATIONS
2386 Bedrock Well
5687 Alluvial Well
SP03-87 Borehole

PROPOSED STAGE 2 SAMPLE LOCATIONS
+ Soilgas
○ Surficial Soil
● HPGe
□ Vertical Soil Profile (Actual location will be selected in the field)
△ Asphalt Sample

0 FEET 50 100 150

FIGURE 56
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Proposed Stage 2 Sample Locations IHSS Nos 138 144(S) 150 6 and 150 8

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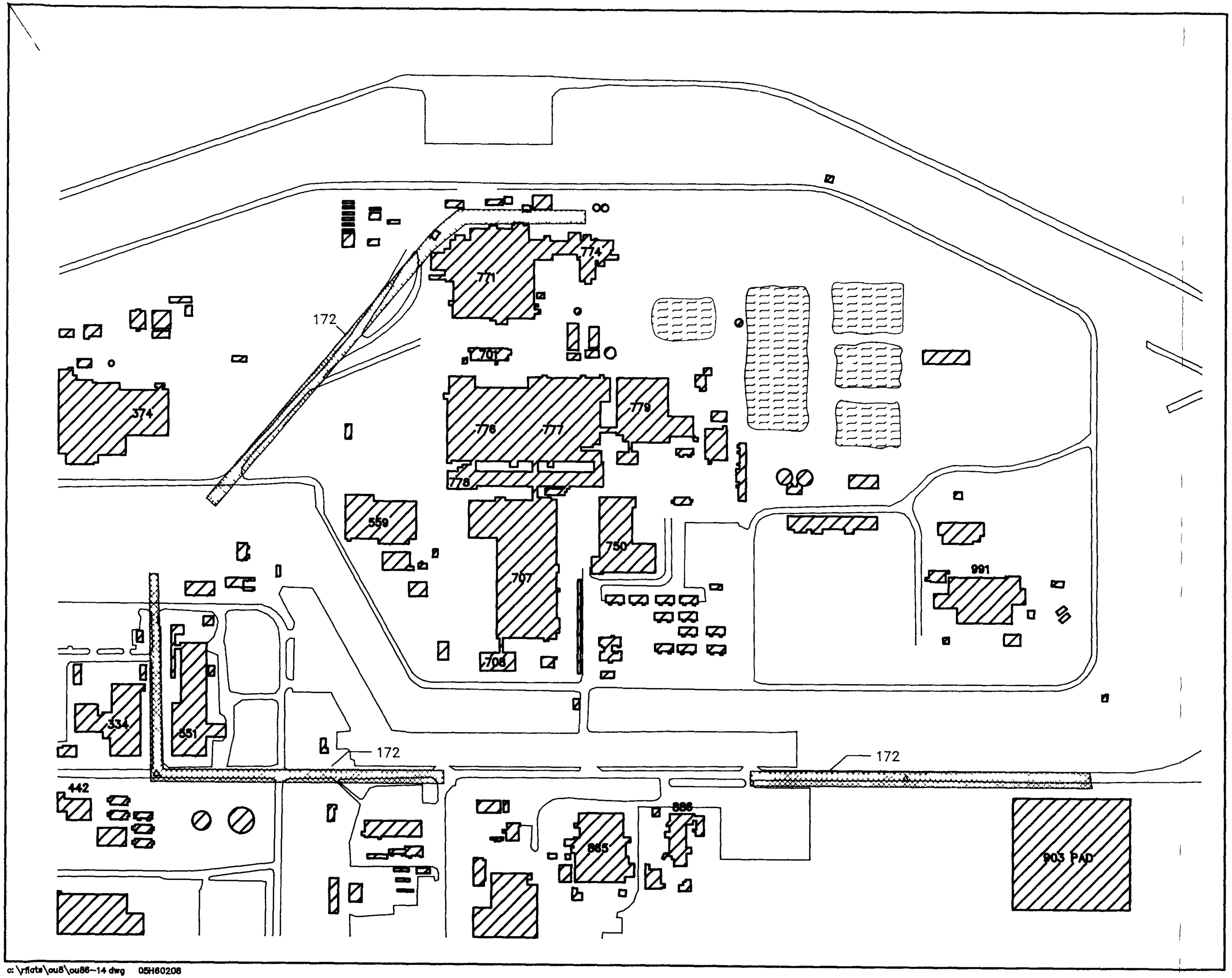

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EXPLANATION

DRAFT

Buildings

Individual Hazardous Substance Sites

Evaporation Ponds

Road

Proposed Asphalt Sample Location

SCALE IN FEET
0 300 600

FIGURE 57
OPERABLE UNIT 8
TECHNICAL MEMORANDUM 1

Proposed Stage 2
Sample Locations
IHSS No 172

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